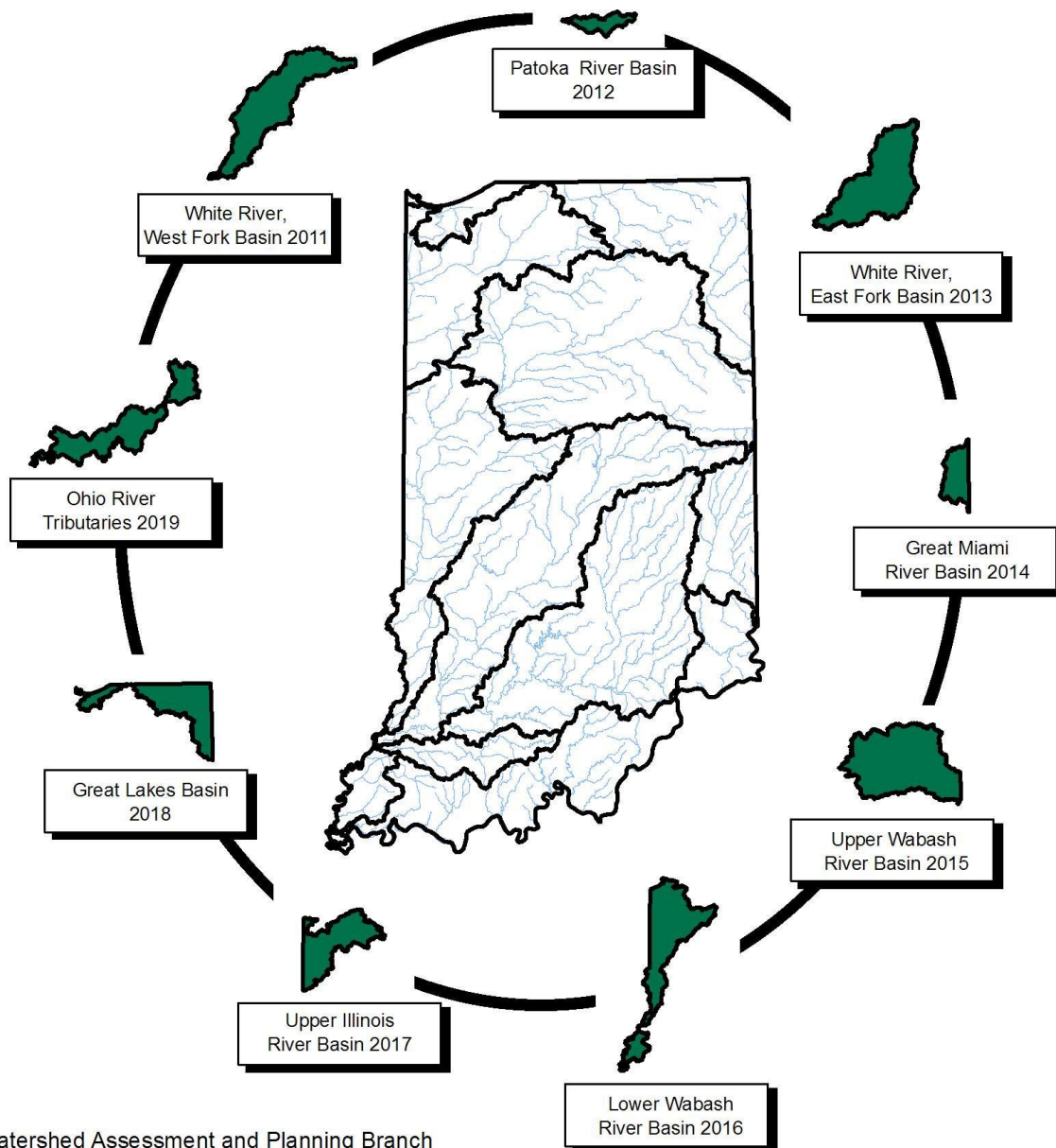




Indiana Water Quality Monitoring Strategy 2011 - 2019



Watershed Assessment and Planning Branch
Office of Water Quality
Indiana Department of Environmental Management

EXECUTIVE SUMMARY

The United States Environmental Protection Agency (U.S. EPA) recommends ten elements which states should include in their water monitoring strategies in order to meet prerequisites of the federal Clean Water Act (CWA) Section 106 (U.S. EPA, 2003).

For the development of this Water Quality Monitoring Strategy (herein referred to as the “*Strategy*”), IDEM convened an interdisciplinary work group comprised of staff from several programs within OWQ, including monitoring staff responsible for collecting the water quality data needed to meet IDEM’s water management needs and staff representing the CWA programs that rely on the data they collect.

This *Strategy* identifies key water quality monitoring objectives and the monitoring approaches used to collect the data necessary to meet them. Some monitoring objectives reflect decision-making processes while others reflect U.S. EPA environmental policy and priorities. The activities related to U.S. EPA priorities or requirements and those related to the protection of human health are ranked as IDEM’s primary priorities. All others are ranked as secondary priorities based on resource constraints and other factors including the degree to which they meet the OWQ mission.

During the development of the *Strategy*, IDEM identified several efficiencies that will enable the agency to better meet more of its primary water monitoring objectives despite consistent reductions of staff and budget to date.

These efficiencies will be achieved through changes in OWQ’s approach to probabilistic monitoring and fixed station monitoring. In order to make best use of limited resources, probabilistic monitoring will be conducted in one basin per year instead of two, which reduces the number of sites to be sampled by 50 percent and allows staff previously assigned to do this work to be reallocated to OWQ’s targeted sampling efforts. Another significant change is the reduction in the frequency at which most fixed stations are monitored, which allows for additional flexibility with current staff and the reallocation of analytical support to targeted monitoring needed to meet primary water monitoring objectives.

These changes provide a much needed balance in IDEM’s overall Water Quality Monitoring Strategy by maintaining IDEM’s ability to provide comprehensive water quality assessments to U.S. EPA and the public for the purposes of CWA Section 305(b) reporting while allowing IDEM to direct a larger share of its ever decreasing monitoring resources to meet U.S. EPA performance measures and other CWA requirements that require targeted monitoring data.

A comprehensive budget for all of OWQ’s monitoring activities is included with this *Strategy*. The total annual costs for OWQ’s surface water monitoring activities described are

approximately \$3 million in addition to the services provided by partnering agencies. OWQ's ground water monitoring activities cost an additional \$1 million annually. Surface water quality monitoring conducted by external organizations with funding from IDEM varies between an estimated \$343,000 and \$403,000 each year.

All available funding for the costs associated with the monitoring activities conducted by OWQ has been allocated to one or more programs to produce a comprehensive budget for planning purposes. Based on this budget, OWQ is currently facing a shortfall of approximately \$558,000 in funds necessary implement this *Strategy*. It is anticipated that some of these monitoring activities will have to be scaled back accordingly, either in terms of the number of sites monitored or the frequency at which they are sampled.

IDEM's Water Quality Monitoring Strategy is considered a "living" document. Given the significant changes to the strategy with this revision, OWQ plans to review the *Strategy* every three years and will and evaluate its monitoring program annually to facilitate the adaptive management necessary order to ensure that these changes are producing the desired results. IDEM will work with U.S. EPA to determine the appropriate timelines for formal review and approval of future revisions to this strategy.

ACKNOWLEDGEMENTS

The development of IDEM's Water Quality Monitoring Strategy: 2011-2019 involved the expertise and contribution of many personnel within IDEM's Office of Water Quality (OWQ). This *Strategy* represents a significant revision from the previous strategy, most notably in terms of IDEM's new approaches to meet its targeting monitoring needs.

The development of the *Strategy* was a collaborative effort in which a primary work group comprised of interdisciplinary staff from several programs within OWQ worked together to make the necessary decisions and consult with other OWQ staff who provided additional input and expertise when needed.

The Editorial Team was tasked with documenting IDEM's *Strategy* and making the significant revisions it required. The Editorial Team also helped to guide the Water Quality Monitoring Strategy Work Group in its discussions to ensure that all the necessary elements of the *Strategy* were covered. The Water Quality Monitoring Strategy Work Group was responsible for reviewing and evaluating the previous strategy and developing new approaches to ensure that IDEM will have the water quality data and information necessary to support its water quality management needs going forward. Other Contributors consisted of OWQ staff who lent their expertise to the process along the way by either participating in the small group discussions or providing input to the work group and/or the Editorial Team as needed.

The OWQ Watershed Assessment and Planning Branch would like to give special thanks to Kristen Brier of IDEM's Office of Pollution Prevention and Technical Assistance for facilitating the Water quality Monitoring Strategy Work Group throughout the planning process and to acknowledge all those cited below for their hard work and dedication to developing IDEM's Water Quality Monitoring Strategy: 2011-2019.

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LIST OF ACRONYMS

ADB: Assessment Database

AIMS: Assessment Information Management System Database

AIMS II: Assessment Information Management System Database II

AUID: Assessment Unit Identification Code

BEACH: Beaches Environmental Assessment and Coastal Health

CALM: Consolidated Assessment and Listing Methodology

CFU: Colony forming units

CLP: Clean Lakes Program

CWA: Clean Water Act

DQA: Data Quality Assessment

DWB: Drinking Water Branch

E.coli: *Escherichia coli*

EnPPA: Environmental Performance Partnership Agreement

FCA: Fish Consumption Advisory

DFW: Division of Fish and Wildlife

GIS: Geographic Information Systems

GWMN: Ground water Monitoring Network

HUC: Hydrologic Unit Code

IBI: Index of Biotic Integrity

IDEM: Indiana Department of Environmental Management

IDNR: Indiana Department of Natural Resources

IGS: Indiana Geological Survey

IR: Indiana Integrated Water Monitoring and assessment Report

ISDH: Indiana State Department of Health

ITSI: Indiana Trophic State Index

IU/SPEA: Indiana University, School of Public and Environmental Affairs

MCL: Maximum Contaminant Level

MDL: Method Detection Limit

mIBI: Macroinvertebrate Index of Biotic Integrity

mL: milliliter

NHD: National Hydrography Dataset

NPDES: National Pollutant Discharge Elimination System

NPS: Nonpoint Source

NWI: National Wetland Inventory

OWQ: Office of Water Quality (at IDEM)

PCB: Polychlorinated Biphenyl

ppb: parts per billion

PWS: Public Water Supply

QA: Quality Assurance

QAPP: Quality Assurance Project Plan

QA/QC: Quality Assurance/Quality Control

QC: Quality Control

QHEI: Qualitative Habitat Evaluation Index

QMP: Quality Management Plan

SOP: Standard Operating Procedure

STORET: Storage and Retrieval Database

SDWA: Safe Drinking Water Act

TMDL: Total Maximum Daily Load

U.S. EPA: United States Environmental Protection Agency

USFWS: United States Fish & Wildlife Service

USGS: United States Geological Survey

WAPB: Watershed Assessment and Planning Branch

WQMS: Water Quality Monitoring Strategy

WQS: Water Quality Standards

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1 INTRODUCTION

The United States Environmental Protection Agency (U.S. EPA) recommends ten elements which states should include in their water monitoring framework in order to meet prerequisites of the federal Clean Water Act (CWA) Section 106 (U.S. EPA, 2003). These elements are briefly described here to provide a context in which to understand IDEM's water quality monitoring strategy and a "road map" to guide readers through the document:

Monitoring Program Strategy – This document in its entirety describes Indiana Department of Environmental Management's (IDEM's) comprehensive monitoring strategy for collecting the data and information needed to address its water quality management needs. Section 1 provides an overview of how IDEM developed its monitoring strategy, summarizes major changes since the last revision and the rationale for those changes.

Monitoring Objectives – Section 2 describes IDEM's water quality monitoring objectives, which serve as the basis for its water quality monitoring strategy and which the resulting data are intended to meet.

Monitoring Design – Section 3 describes the different monitoring designs that IDEM employs to meet its water quality management objectives.

Core and Supplemental Indicators – Section 4 describes the environmental indicators that are or can be monitored to help IDEM meet its water quality management objectives.

Quality Assurance – Section 5 describes IDEM's quality assurance and quality control processes for ensuring that the data collected to meet its water quality management needs are scientifically sound and valid.

Data Management – Section 6 describes IDEM's systems for managing water quality data and assessment information.

Analysis and Assessment – Section 7 describes how monitoring data are used to meet the water quality management needs identified in this strategy.

Reporting – Section 8 describes how water quality monitoring data and analytical results are reported, including in IDEM's Integrated Water Monitoring and Assessment Report (IR) pursuant to CWA Sections 305(b) and 303(d) and in other types of reports required by U.S. EPA, such as reporting on performance measures required by U.S. EPA's Strategic Plan.

Programmatic Evaluation – Section 9 of this strategy provides a timeline for review and revision of IDEM's *Strategy* and describes the process by which IDEM Office of Water Quality (OWQ) will evaluate its effectiveness in meeting IDEM's water quality management needs.

General Support and Infrastructure Planning – Section 10 identifies current and future resources needed to fully implement its monitoring strategy for meeting all of IDEM’s water quality management needs.

With these ten elements in mind, and drawing from Indiana’s past water quality monitoring activities, the Indiana Department of Environmental management (IDEM) Office of Water quality (OWQ) has developed this Water Quality Monitoring Strategy 2011-2019 (herein referred to as the “*Strategy*”). This *Strategy* will guide IDEM’s water quality monitoring in Indiana for the next nine years and provides a comprehensive approach to water quality monitoring. Successful implementation of this *Strategy* is expected to result in data of the appropriate type and of sufficient quantity and quality necessary to meet the water quality management needs of all types of water resources in Indiana including streams, rivers, lakes, reservoirs, near-shore Lake Michigan, wetlands, and ground water.

The *Strategy* uses a watershed approach to prioritize water quality management needs and the monitoring activities intended to meet them. Most of the monitoring described herein is conducted by the Watershed Assessment and Planning Branch (WAPB) within IDEM OWQ. The WAPB includes several CWA programs and conducts a wide range of monitoring activities in order to meet the needs of CWA programs that reside within the branch and in other branches and programs within IDEM.

1.1 PAST WATER MONITORING STRATEGIES

IDEM developed its first water quality monitoring strategy in 1995 to guide its monitoring efforts from 1996-2000 (IDEM, 1995). Although this *Strategy* was endorsed by U.S. EPA, IDEM found it necessary in 1998 to revise it earlier than originally intended in response to unforeseen reductions in staff and resources (IDEM, 1998). At this time, there was also a corresponding increase in monitoring needed for the development of Total Maximum Daily Loads (TMDLs), which required a reallocation of staff and fiscal resources. IDEM revised its *Strategy* again in 2001 to cover the years 2001-2005. IDEM made no significant changes to its monitoring programs for this revision. When IDEM revised the *Strategy* for the years 2006-2010, it added information regarding wetlands and ground water and outlining a plan to address the water quality management needs associated with these water resources. The 2006 revision also included more information regarding core and supplemental indicators and methods for evaluating its monitoring programs (IDEM, 2006).

In its review of the 2006-2010 *Strategy*, U.S. EPA identified the need for a more specific plan for obtaining the data necessary to support IDEM’s Nonpoint Source Program needs and to evaluate the effectiveness of the Nonpoint Source Program at reducing the effects of nonpoint source pollution to Indiana waters. U.S. EPA also cited a need for better inter-program

coordination for the purposes of planning monitoring activities and to identify programmatic efficiencies that could result in data usable for multiple management objectives. With this revised *Strategy*, IDEM followed U.S. EPA's recommendations both in terms of the process used to develop a comprehensive water monitoring strategy and the resulting changes in IDEM's water monitoring programs.

1.2 DEVELOPMENT OF IDEM'S WATER MONITORING STRATEGY FOR 2011-2019

For the development of this *Strategy*, IDEM convened an interdisciplinary work group comprised of staff from several programs within OWQ, including monitoring staff responsible for collecting the water quality data needed to meet IDEM's water management needs and staff representing the CWA programs that rely on the data they collect. Throughout the development of this *Strategy*, the work group consulted with staff in other OWQ programs for additional input and expertise as needed to ensure that all of IDEM's water monitoring objectives were identified and considered.

The work group collaborated over a period of several weeks to discuss the *Strategy* and to determine the changes needed to meet IDEM's various water monitoring objectives. Smaller groups were convened as needed to evaluate new monitoring approaches, discuss changes necessary to existing approaches, and to resolve specific issues or questions. These small groups then presented their findings and recommendations to the larger work group for further discussion and decision-making.

IDEM plans to convene a similar, but smaller group on an annual basis to plan its targeted monitoring activities for the each sampling season. The annual planning work group will include staff in each of OWQ's water monitoring programs and staff from the OWQ programs who are the primary users of the data they collect. These staff will collaborate in planning the location, nature and scope of the OWQ's targeted monitoring activities.

This *Strategy* is considered by IDEM to be a "living" document. In order to allow for the adaptive management necessary to ensure that it continues to meet OWQ's monitoring objectives and water quality management needs, IDEM plans to reconvene the Water Monitoring Strategy Work Group every three years to review the *Strategy* and evaluate its monitoring programs. Any significant revisions to the *Strategy* will be informally submitted to U.S. EPA for evaluation and comment prior to their implementation. IDEM will work with U.S. EPA to determine the appropriate timelines for formal review and approval.

1.3 CONFLICTING MONITORING NEEDS AND CHANGES TO IDEM'S STRATEGY

IDEM's *Strategy* for 2011-2019 reflects a significant increase in OWQ's targeted monitoring efforts made possible for the most part by changes in its approach to probabilistic monitoring

and fixed station monitoring. These changes are intended to address conflicting monitoring needs that IDEM has struggled with in recent years.

1.3.1 CHANGES TO IDEM'S PROBABILISTIC MONITORING APPROACH

U.S. EPA emphasizes a probabilistic monitoring approach in order to help states meet the CWA Section 305(b) goal of comprehensively monitoring all waters of the state. While the probabilistic study design allows states to make statistical inferences regarding the extent to which waters of the state, as a whole, support or do not support their designated uses, the randomness built into the probabilistic study design does not allow for continued monitoring of those streams where impairments have been identified. For these waters, follow-up monitoring is needed to determine the full extent of impairment and the stressors and/or sources of pollutants driving the impairments in order to develop the total maximum daily loads (TMDLs) required by CWA Section 303(d) and facilitate restoration.

TMDL development is one of a number of water quality management needs that require targeted monitoring data. U.S. EPA also requires states to meet performance measures aimed at quantifying improvements in water quality resulting from the implementation of TMDLs and watershed planning and restoration activities funded through CWA Section 319 grants and other OWQ programs.

IDEM's previous strategies have mirrored U.S. EPA's emphasis on probabilistic monitoring. In the past, IDEM's targeted monitoring programs have been comparatively limited because the minimum number of samples required to maintain the statistical rigor required by IDEM's probabilistic sampling design typically consume most of OWQ's monitoring resources. As a result, IDEM's OWQ has struggled to meet its targeted monitoring needs.

IDEM recognizes the importance of continued probabilistic monitoring in order to meet the CWA objectives to monitor and report on water quality conditions throughout Indiana. At the writing of this report, IDEM has completed more than three full rounds of probabilistic monitoring, providing U.S. EPA with the data necessary to conduct comprehensive assessments for the entire state for both aquatic life use support and recreational use support based on probabilistic monitoring results.

IDEM's previous strategies employed a five-year rotating basin approach, monitoring in 1-2 basins each year, allowing OWQ to complete one full round of monitoring the entire state every five years. Beginning with the 2011 monitoring season, IDEM will continue to use a rotating basin approach, but will conduct its probabilistic monitoring in one basin each year, resulting in a nine-year rotation.

A nine-year rotation will extend the amount of time needed to monitor the entire state. However, this approach achieves a much needed balance in IDEM's overall *Strategy* by maintaining IDEM's ability to provide comprehensive water quality assessments to U.S. EPA and the public for the purposes of CWA Section 305(b) reporting while allowing IDEM to direct a larger share of its ever decreasing monitoring resources to meet U.S. EPA performance measures and other CWA requirements that require targeted monitoring data. While the change to a nine-year rotating basin strategy alone does not provide the resources needed to fully implement this *Strategy*, the advantages of this approach include:

- *The ability to more accurately characterize water quality impairments identified through probabilistic monitoring* – Increased targeted monitoring will allow IDEM to better define the boundaries of impairments to facilitate prioritization of limited restoration funds. Targeted monitoring will also allow IDEM to identify the specific sources/stressors driving impairments identified through probabilistic monitoring to provide more detailed information for TMDL development and better decision-making with regard to the types of practices needed to improve water quality.
- *Increased flexibility with current staffing* – A nine-year rotating basin approach reduces the number of probabilistic samples collected each season by half while still allowing IDEM to meet the monitoring objectives associated with probabilistic monitoring. This, combined with the reduction in staff travel (from two basins to one) will free existing staff to conduct targeted monitoring projects without having to add new positions and will result in some cost savings achieved through logistical efficiencies.
- *The ability to focus more resources on showing improvements in watersheds* – The nine-year rotating basin approach will allow IDEM to reallocate staff resources and funding to monitoring watersheds in which implementation and other restoration activities have occurred.
- *The ability to increase the pace at which IDEM develops TMDLs* – A reduction in the number of newly identified impairments may reduce the pace at which IDEM is required to develop TMDLs. In the past two cycles, IDEM's TMDL development has managed to keep pace with the number of new impairments added to the list but has lacked sufficient monitoring resources to go above and beyond this. With current staffing levels and more resources allocated to TMDL monitoring, IDEM might reasonably be able to increase the pace at which it develops TMDLs, reducing the total number of 303(d) listed waters as opposed to merely keeping it in check.

More time for restoration and other activities aimed at improving water quality to take effect – Time scales at which various best management practices, minimum control measures and other activities required by IDEM’s CWA permit programs will produce a measurable change in water quality commonly exceed five years. A nine-year rotating basin approach increases the likelihood of detecting measurable changes resulting from such activities.

1.3.2 CHANGES TO IDEM’S FIXED STATION MONITORING APPROACH

IDEM is also reducing the frequency of its fixed station monitoring. This approach is described in more detail in later sections of this *Strategy*, but for most fixed stations, sampling will be conducted quarterly now as opposed to monthly. However, monthly monitoring will continue at a limited number of sites to support IDEM’s National Pollutant Discharge Elimination System Program needs.

Fixed station monitoring data represents the agency’s longest running data set available for analyzing trends in water quality. Reducing the frequency at which fixed stations are monitored will reduce the resolution of the data limiting IDEM’s ability to do some types of trend analyses. However, most of the same stations will continue to be sampled, providing the continuity necessary to determine meaningful trends. After careful consideration of IDEM’s monitoring objectives in terms of their relative priority and the resources needed to meet them, it was determined that continued monitoring of the fixed stations at a reduced frequency would allow the agency to maintain its ability to conduct trend analyses with fixed station data while at the same time, reallocating significant sources to conduct the targeted monitoring necessary to meet critical objectives.

2 MONITORING STRATEGY OBJECTIVES

IDEM’s role in the protection and restoration of its water resources is reflected in the OWQ mission to “monitor, protect, and improve Indiana's water quality to ensure its continued use as a drinking water source, habitat for wildlife, recreational resource and economic asset.” The Watershed Assessment and Planning Branch (WAPB) plays a critical role in this mission by administering several CWA programs and collecting the water quality data and information necessary to support these and other programs throughout the OWQ.

The WAPB’s goals are to monitor, assess, and facilitate the protection and restoration of the designated uses of all waters of the state and to evaluate the effectiveness of our programs. The WAPB accomplishes this by:

- Conducting monitoring activities to provide water quality data that will support multiple water quality management needs of the OWQ CWA programs administered by the WAPB and those of programs which reside in other OWQ branches.

- Using the water quality data collected by WAPB monitoring programs to more effectively implement CWA programs and evaluate their effectiveness in protecting and restoring Indiana waters.
- Providing water quality data and information to support other water quality management programs in partnership with external customers and stakeholders.

IDEM's ground water monitoring activities are implemented by OWQ's Drinking Water Branch (DWB) and are included in this *Strategy* to provide a comprehensive picture of all of OWQ's water monitoring activities.

2.1 WATER QUALITY MONITORING OBJECTIVES

IDEM's water quality monitoring objectives that provide the basis for the water monitoring programs described in this *Strategy* are summarized in Table 1. Due to the diversity of Indiana's water resources and the management activities necessary to protect and restore them, IDEM must necessarily prioritize its limited resources to ensure that its water quality management needs can be met.

Some of the objectives shown reflect decision-making processes while others reflect U.S. EPA environmental policy and priorities. All of them require water quality monitoring data. The activities related to U.S. EPA priorities or requirements and those related to the protection of human health are ranked as IDEM's primary priorities. All others are ranked as secondary priorities based on resource constraints and other factors including the degree to which they meet the OWQ mission. These priorities are reflected in Table 1, and a key is provided to facilitate linking these monitoring objectives with the core and supplemental indicators (identified in Section 4 of this document) that are needed to meet them.

As shown in Table 1, OWQ's monitoring objectives may be met by one or more of the following three primary monitoring approaches:

Probabilistic Monitoring – Probabilistic monitoring employs a stratified probabilistic sampling design which provides data that OWQ can use to make water quality assessments on two spatial scales. The probabilistic design allows OWQ to make statistically valid, unbiased and comprehensive assessments of the degree to which each basin as a whole is supporting its beneficial uses based on data collected throughout the state. OWQ also uses these data to make reach-specific assessments of the degree to which the individual streams or stream reaches sampled are supporting their beneficial uses as designated in Indiana's water quality standards (WQS). Both types of water quality assessments meet key CWA objectives. However, due to the randomness built into the study design the probabilistic approach does not ensure continued monitoring of waters sampled in previous years.

Targeted Monitoring – Unlike the probabilistic approach to monitoring, targeted monitoring designs involve the intentional selection of sampling locations based on the specific monitoring objective to be met. Many of IDEM’s monitoring objectives require a targeted approach to monitoring which may vary in terms of location, parameters, monitoring frequency, etc. Generally, OWQ’s targeted monitoring approaches are designed to meet specific needs but are leveraged where possible to meet multiple water monitoring objectives.

Fixed Station Monitoring – Fixed station monitoring is also a targeted monitoring approach. For the purposes of this *Strategy*, Fixed station monitoring is treated as a separate approach because unlike OWQ’s other targeted monitoring designs, sampling locations typically do not change from year to year.

Table 1: OWQ's primary and secondary water quality monitoring objectives and the types of monitoring approaches needed to meet them. Some objectives may be met with data from a combination of monitoring approaches. The monitoring approaches identified in bold font represent the primary approaches used to obtain the necessary data for a given objective.

Key	Monitoring Objective	Priority	Probabilistic	Targeted	Fixed Station
A	Conduct water quality assessments pursuant to CWA Section 305(b) to support the development of Indiana's Integrated Report to U.S. EPA	Primary	X	X	X
B	Development of Indiana's CWA Section 303(d) List of Impaired Waters for Indiana's Integrated Report	Primary	X	X	X
C	Develop Total Maximum Daily Loads to address impairments identified on Indiana's 303(d) list	Primary	X	X	X
D	Determine trends and trophic status of Indiana's lakes and reservoirs under CWA Section 314	Primary		X	
E	Develop water quality criteria, including nutrient criteria for lakes and reservoirs, rivers and streams	Primary	X	X	
F	Support watershed planning and restoration efforts	Primary	X	X	X
G	Identify water quality improvements accomplished by watershed restoration efforts funded through CWA programs	Primary		X	
H	Support the development of public health advisories related to the use of Indiana's water resources, including fish consumption advisories and recreational use advisories	Primary		X	
I	Determine ambient ground water quality and extent of contaminated areas	Primary		X	
J	Support source water protection including both ground water and surface source water supplies	Primary		X	X
K	Support development of National Pollutant Discharge Elimination System permit limits	Primary	X	X	X
L	Develop environmental indicators, including indices of biological integrity, for use in making water quality assessments	Primary	X		
M	Responding to citizen complaints about activities that may be impacting private wells	Primary		X	

Key	Monitoring Objective	Priority	Probabilistic	Targeted	Fixed Station
N	Provide sampling support to other IDEM program areas as needed	Secondary		X	X
O	Determine trends in water quality for the purposes of reporting to the Indiana Water Pollution Control Board, U.S. EPA, and the public	Secondary	X	X	X
P	Support development of threatened and endangered species lists	Secondary	X	X	
Q	Support the development of tiered aquatic life uses	Secondary	X		

2.1.1 CLEAN WATER ACT SECTION 305(B) DESIGNATED USE ASSESSMENTS

CWA Section 305(b) requires states to monitor waters of the state and determine the degree to which they support the beneficial uses for which they are designated in Indiana's WQS. This includes assessments of how well the water quality supports aquatic life, recreational uses, and human health based on comparison of the available data to the narrative and numeric criteria in Indiana's WQS. For the purposes of CWA Section 305(b), waters are assessed as either fully supporting of the beneficial use in question or impaired (i.e. the water does not fully support the use). The assessments are conducted in accordance with OWQ's Consolidated Assessment and Listing Methodology (CALM).

OWQ currently conducts 305(b) assessments on rivers, streams, lakes and reservoirs. Although Indiana's current WQS do not contain the ground water and wetland water quality criteria necessary to support 305(b) water quality assessments, the *Strategy* supports other monitoring activities aimed at protecting these important water resources.

To make its 305(b) water quality assessments, OWQ may consider data collected under most study designs provided that Indiana's WQS contain numeric criteria and/or IDEM has developed an assessment methodology to apply the narrative criteria for the type of data in question. Given this, most of the water quality data collected by the WAPB, including data from its probabilistic, targeted, and fixed station monitoring activities are used to make CWA 305(b) assessments.

OWQ also routinely solicits data from external organizations and partners for potential use in its 305(b) assessments. Any readily available and existing data that meets OWQ's data quality requirements may be used for assessment purposes. In order to augment the amount of data available to meet its 305(b) monitoring objectives, OWQ is currently working toward the implementation of its External Data Framework. The External Data Framework will provide a

systematic, transparent and voluntary process through which external organizations may submit their water quality data for potential use in OWQ programs.

The External Data Framework does not represent any monitoring activities on the part of OWQ. However, it is anticipated that once implemented, the External Data Framework will help IDEM to meet one/more of its monitoring objectives in the future by providing water quality data for 305(b) assessments and other possible uses by OWQ. IDEM will provide more information on this program with its next revision of the *Strategy* in 2014.

2.1.2 DEVELOPMENT OF THE CLEAN WATER ACT SECTION 303(D) LIST OF IMPAIRED WATERS

Under CWA Section 303(d), states are required to develop a list of those waters, including rivers and streams, lakes and reservoirs, which are not supporting one or more of their beneficial uses and require a TMDL. The impairments that appear on Indiana's 303(d) list are most often identified through OWQ's CWA 305(b) assessment process. Impairments may also be identified through TMDL development, which occurs after an original impairment has been identified. In order to develop a TMDL, OWQ collects additional data, which when assessed, commonly reveal additional impairments. Regardless of the process through which impairments are identified (through OWQ's 305(b) assessments or TMDL development), they are all assessed in accordance with the CALM and consider all readily existing and available data. Therefore, this monitoring objective may be met by most all of the WAPB's monitoring programs and with data provided through partnerships with external partners.

2.1.3 TOTAL MAXIMUM DAILY LOAD DEVELOPMENT

The requirement to develop Total Maximum Daily Loads (TMDLs) also comes from CWA Section 303(d). This monitoring objective relies primarily on OWQ's targeted monitoring efforts to provide the data necessary for TMDL development. However, the process considers all available data for the watershed, including data collected by OWQ's probabilistic and fixed station monitoring activities. Data are also solicited from interested parties external to IDEM. Load calculations in the TMDL are based only on water quality data that meet OWQ's data quality requirements, regardless of their source.

2.1.4 CWA SECTION 314 ASSESSMENTS OF TRENDS AND TROPHIC STATUS OF INDIANA LAKES AND RESERVOIRS

CWA Section 314 requires states to assess the trophic status and trends of all publicly owned lakes in Indiana. To date, IDEM has met this monitoring objective through a contractual agreement with Indiana University School of Public and Environmental Affairs (IU/SPEA) to

administer the Indiana Clean Lakes Program (CLP). In collaboration with OWQ, the IU/SPEA conducts the monitoring needed to meet IDEM's CWA 314 objectives and then provides the data to OWQ for use in its assessment processes. Develop water quality criteria, including nutrient criteria for lakes and reservoirs, rivers and streams

Under CWA Section 303(c), U.S. EPA has mandated that states develop and adopt nutrient criteria into their water quality standards. In 2001, U.S. EPA published recommended water quality criteria for both causal variables (total nitrogen and total phosphorus) and response variables (*Chlorophyll a* and turbidity/water clarity) in the federal register (66 FR 1671). These criteria were developed by waterbody type for 'aggregated' nutrient ecoregions based on the work of Omernik and Gallant (1988) using existing water quality data that met certain selection criteria at the time of analysis (U.S. EPA 2000a, b, and c).

U.S. EPA has encouraged states to modify or refine the published criteria to reflect conditions on a smaller geographic scale. U.S. EPA strongly recommends that development of nutrient criteria be supported by multiple lines of evidence to support the scientific validity of the final criteria proposed. Rather than adopt U.S. EPA's published criteria, IDEM has chosen to develop nutrient criteria based on data that are more representative of Indiana waters in terms of waterbody type, aquatic communities, and other relevant variables specific to Indiana waters.

IDEM has made significant progress in its development of nutrient criteria for lakes and in July 2010 completed the first notice of rulemaking. The data used to develop nutrient criteria for lakes and reservoirs was targeted data collected primarily through OWQ's CLP.

Determining cause and effect relationships between nutrients and aquatic communities in rivers and streams has proven more difficult. Most of the data analyzed to date has been collected through OWQ's probabilistic monitoring activities as well as cooperative monitoring projects with the United States Geological Survey (USGS). OWQ continues to collect additional data for developing nutrient criteria for rivers and streams by using multiple lines of evidence approach.

2.1.5 SUPPORT FOR WATERSHED MANAGEMENT PLANNING AND RESTORATION ACTIVITIES

CWA Section 319 provides funding for various types of projects that work to reduce nonpoint source water pollution. These funds are administered by OWQ's Nonpoint Source Program, which provides grants to watershed groups and other organizations for watershed management planning and restoration activities. Watershed plans funded through CWA Section 319 must:

- Identify the causes of impairment within their watershed(s), the sources and/or stressors driving them, and the load reductions or other activities needed to control them.
- Identify and prioritize the critical areas in need of implementation measures to reduce nonpoint source pollution.
- Include a monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against a set of defined criteria that can be used to determine whether loading reductions are being achieved and whether progress is being made toward attaining water quality standards.

These monitoring objectives require targeted monitoring data to meet. However, for the purposes of identifying impairments within their watersheds, nonpoint source projects may also draw upon other types of data such those available through OWQ's fixed station and probabilistic monitoring activities.

Watershed groups and other organizations participating in watershed planning and restoration activities may use data from any source, including but not limited to data collected by IDEM. Watershed groups commonly conduct their own monitoring. Any monitoring activities funded through IDEM's Nonpoint Source Program must be conducted under a quality assurance project plan (QAPP) approved by OWQ's Nonpoint Source Program prior to initiation of monitoring activities. To provide support to watershed management planning activities, OWQ may conduct monitoring for the watershed groups either to augment the data the group plans to collect or in lieu of the group conducting its own monitoring.

This type of monitoring represents a significant revision to OWQ's *Strategy*. And, the processes for identifying which watersheds will receive monitoring assistance have not been fully developed. The selection of the watershed chosen for monitoring assistance in 2001 was based on the following criteria:

- The project selected is new proposal for the 2011 funding cycle and does not yet have a monitoring program in place to support its planning activities.
- The project ranked highly in the proposal selection process and had already been selected for funding.
- The project selected needed the monitoring assistance more than other projects slated for funding, which already have the necessary capacity to conduct their own monitoring.

IDEM anticipates that its process for selecting watersheds for monitoring assistance will be refined by the end of 2011, which is when OWQ will have its first opportunity to evaluate the new targeted monitoring approaches initiated with this *Strategy*. IDEM will provide more detail regarding its watershed selection process with the next revision of the *Strategy* in 2014.

2.1.6 IDENTIFY WATER QUALITY IMPROVEMENTS ACCOMPLISHED BY WATERSHED RESTORATION EFFORTS FUNDED THROUGH CWA PROGRAMS

This monitoring objective comes from the National Water Program Guidance issued by U.S. EPA (U.S. EPA, 2010), which defines the measures to be used to assess progress in meeting the goals outlined in its Strategic Plan. This guidance contains both administrative and environmental performance measures for many of IDEM's CWA programs. IDEM's *Strategy*, addresses those measures which require water quality monitoring data.

WQ-10 (or "Nonpoint Source Success Stories") – This performance measure requires that states develop "NPS Success Stories" and submit them to U.S. EPA for the purposes of tracking how NPS restoration efforts are improving water quality. To meet this measure, OWQ must identify nonpoint source-impaired waters that have been improved as a result of watershed restoration efforts funded in part or whole by IDEM's Nonpoint Source Program.

SP-10 – This measure tracks the number of waters listed as impaired on Indiana's 303(d) list for one or more impairments which have since been fully restored. To meet this measure, the water(s) in question must be meeting all applicable water quality criteria for all impairments (except for mercury) that were originally identified on the 303(d) list for 2002. Pollutants or impairments that are identified on subsequent 303(d) lists are not considered for this measure although U.S. EPA may adjust the baseline to a different base year in the future.

SP-11 (or "Measure L") – This measure requires that OWQ show improvements in water quality conditions in terms of individual impairments. For the purposes of meeting this performance measure, improvements may be demonstrated by any delisting based on water quality data showing the waterbody is meeting all applicable water quality criteria for the impairment listed.

SP 12 (or "Measure W") – This measure requires that OWQ show improvements in water quality conditions in impaired watersheds that have resulted from watershed planning and restoration activities. For the purposes of meeting this performance measure, improvements may be demonstrated by the delisting of at least 40 percent of the impairments or impaired miles/acres in the watershed or valid scientific information that indicates significant watershed-wide improvement in one or more water quality parameters associated with the impairments listed in 2002.

All of these U.S. EPA performances measures involve identifying where water quality improvements are occurring, either as a result of OWQ grant funded watershed planning and restoration efforts or for other reasons. To meet this monitoring objective, OWQ must conduct targeted monitoring of waters previously identified as impaired on Indiana's 303(d) list, with an emphasis on those watersheds where restoration efforts are known to have occurred.

2.1.7 DEVELOPMENT OF PUBLIC HEALTH ADVISORIES

In Indiana, the responsibility to develop and issue public health advisories is delegated to the Indiana State Department of Health (ISDH) and local health departments. Because the protection of human health is central to IDEM's mission, OWQ actively participates in the development of public health advisories regarding the use of Indiana's water resources.

OWQ conducts monitoring to provide water quality and other data needed for the development of fish consumption advisories and toxic algae alerts, both of which are issued through ISDH. IDEM also administers the Beaches Environmental Assessment and Coastal Health Act (BEACH Act) programs in Indiana, which provide grants to municipalities to conduct bacterial water quality monitoring for the purpose of issuing swimming advisories for their beaches.

ISDH Fish Consumption Advisory (FCA) –The annual *Indiana Fish Consumption Advisory* is the product of the collaborative efforts of the ISDH, IDEM, and the Indiana Department of Natural Resources (IDNR) with support from Purdue University. Much of the data used for the development is collected by IDEM OWQ's fish tissue monitoring, and OWQ staff routinely participate in the data analysis necessary to develop the FCA. The FCA is based on the statewide collection and analysis of fish samples for long-lasting contaminants found in fish tissue, such as polychlorinated biphenyls (PCBs), organochlorine pesticides, and/or heavy metals (e.g., mercury).

Toxic Algae Alerts – Due to concerns about blue-green algal blooms in several of the state's reservoirs, IDEM applied for and received a CWA Supplemental 106 grant in 2010 to develop internal capacity to monitor blue-green algae populations and analyze for the presence of the Microcystin algal toxin. The goal of this program is to be able to inform the public when recreation in water with high blue-green algal cell counts and/or Microcystin toxin levels is not recommended. In 2010, IDEM sampled five IDNR managed swimming beaches, and in 2011 will sample a total of ten. The public is kept informed of the status of the sampled reservoirs by the www.algae.IN.gov website, which also incorporates public health information related to blue-green algae from the ISDH as well as other relevant information from government agencies and educational institutions. Once the two-year grant period is over, IDEM intends to incorporate a blue-green algae monitoring program as a part of its overall water monitoring strategy.

Beach Notifications – IDEM provides BEACH Act funds to coastal communities to increase the frequency and/or maintain the current level of monitoring at their beaches. IDEM's Northwest Regional Office administers the federal BEACH Act programs, which provides multiple resources to local communities, allowing equipment upgrades, supply purchases, and additional summer staff to collect and analyze samples.

Prior to the development of Indiana's Beaches Monitoring and Notification Program, Indiana's 22 coastal beaches were monitored 1-2 times per week or not at all. The funding has allowed for more partner communities to participate in monitoring their beaches, as well as increasing the frequency of the bacterial sampling and analysis at the beaches to 5-7 days per week.

Although IDEM does not directly participate in these monitoring activities, they are included in this *Strategy* as an important monitoring objective that is met through collaborative partnerships with other organizations.

2.1.8 DETERMINE GROUND WATER QUALITY AND EXTENT OF CONTAMINATED AREAS

CWA Section 106(e) requires that in order to receive federal CWA Section 106 funds, states must monitor water quality including “navigable waters and to the extent practicable, ground waters”. Under CWA Section 305(b), U.S. EPA also encourages states to include in their Integrated Water Monitoring and Assessment Reports a description of the nature and extent of ground water pollution any recommendations made by state plans or programs to maintain or improve ground water quality.

Characterizing ambient ground water quality is an important first step in protecting its use as a drinking water resource. Public water supply is designated in Indiana’s WQS as a beneficial use that must be protected and maintained. Although the criteria contained in Indiana’s WQS are applicable only to surface water, approximately 55 percent of Indiana’s public water supplies (PWS) rely on ground water. Given this, the objectives associated with the protection of source water cannot be met with surface water monitoring alone.

To more provide the information necessary to more comprehensively address the full range of Indiana’s water resource management needs, OWQ’s Drinking Water Branch (DWB) initiated its Ground Water Monitoring Network in 2008 to:

- Characterize the ambient quality of ground water in Indiana’s different hydrogeologic settings and determine the nature, extent and sources of ground water quality contamination throughout the state;
- Gain a better understanding of ground water/surface water interactions including how point source and non-point source loading from ground water influences surface water quality and vice versa;
- Inform source water protection efforts by identifying geographic areas where water quality constituents represent a risk to human health and determining the extent to which human activities may be threatening drinking water supplies, particularly in source water aquifers which feed PWS well fields.

The Ground Water Monitoring Network provides a framework for assessing the status of Indiana’s ground water resources and is augmented with information collected through OWQ’s

Fixed Station Monitoring Program and other surface water monitoring programs where possible. Together, these monitoring activities provide good indicators of both the current state of the water supply and the susceptibility of source water to contamination.

2.1.9 CITIZEN COMPLAINT MONITORING

IDEM does not have regulatory authority over private drinking water wells. However, many citizens rely on private wells for their drinking water. Given this, the DWB in OWQ has implemented a Private Well Complaint Response Program and provides homeowners information on how to protect their wells online at: www.in.gov/idem/4281.htm. The Private Well Complaint Response Program receives complaints, investigates, and samples at-risk private water wells which are suspected of being contaminated by man-made contaminants.

2.1.10 SUPPORT DEVELOPMENT OF NPDES PERMIT LIMITS

When modeling water quality in support of National Pollutant Discharge Elimination System (NPDES) permits, the OWQ Permitting Branch uses all available water quality data. Frequently, this includes the data collected at WAPB fixed station monitoring sites. The long-term data can provide a temporal trend of baseline water quality, aiding in the characterization of a stream receiving permitted effluent. The NPDES Program may also utilize data collected through the WAPB's other monitoring activities to support this objective if appropriate.

2.1.11 PROVIDE SAMPLING SUPPORT TO OTHER IDEM PROGRAM AREAS AS NEEDED

One of the WAPB's responsibilities is to provide monitoring and assessment assistance as needed to various program areas within OWQ and other IDEM offices. Requests for assistance might include: 1) sampling to support enforcement and compliance activities 2) sampling that is requested to address a specific water quality complaint or concern 3) collecting flow measurements for modeling purposes, and 4) responding when requested to spill or fish kill incidents.

These requests are accommodated through the coordination and implementation of Special Studies, which are short-term targeted monitoring projects designed to meet the unique needs of the program requesting the assistance. Because such requests are relatively infrequent, they are considered a secondary responsibility relative to other monitoring objectives outlined in this *Strategy*, and the necessary monitoring is generally worked into the WAPB's routine sampling activities as time and resources allow. However, such requests do have the potential to become a primary objective based on the urgency of the issue for which monitoring support is requested, and depending on the scope of the issue at hand, Special Studies may require a temporary but significant reallocation of staff resources in order to respond in a timely manner.

2.1.12 DEVELOP ENVIRONMENTAL INDICATORS TO SUPPORT WATER QUALITY ASSESSMENTS

U.S. EPA recommends the use of multiple biological indicators, which facilitate a “weight-of-evidence” approach to interpretation of biomonitoring results. This approach involves interpreting data from multiple sources to arrive at conclusions about an environmental system or stressors such as nutrients. Multiple lines of evidence utilizing more than one bioindicator can be valuable in corroborating critical levels of nutrients to stream biota.

In an effort to develop algal metrics for Indiana streams and rivers, IDEM is proposing to include algal identification and enumeration as part of its probabilistic sampling activities for years 2010 and 2011. Studies have shown that algal community metrics are a more precise indicator of nutrient enrichment compared to other response variables. One goal of this program is to determine if periphyton diatom data will indicate a stronger correspondence with nutrients than fish or invertebrate metrics. Using data collected from this project, IDEM intends to develop algal metrics which will be used to support nutrient criteria being developed for Indiana’s rivers and streams.

2.1.13 SUPPORT DEVELOPMENT OF THREATENED AND ENDANGERED SPECIES LISTS

U.S. Department of Fish and Wildlife (USFWS) works with the IDNR Division of Fish and Wildlife (DFW) to develop and maintain the threatened and endangered species list required under the Federal Endangered Species Act. Although IDEM has no regulatory responsibility in the development of these lists, occasionally opportunities arise to leverage funds for the purposes of conducting biological monitoring in support of this and other monitoring objectives. The data provided through such collaborative efforts are used by USFWS and IDNR to develop and maintain their threatened and endangered species lists and by IDEM to meet one/more of its monitoring objectives.

In addition to participating in collaborative monitoring efforts whenever possible, OWQ routinely communicates with the USFWS and IDNR DFW whenever threatened or endangered species are identified as a result of its regular biological sampling activities.

2.1.14 DETERMINE AND ANALYZE TRENDS IN WATER QUALITY

Determining water quality trends is becoming more important with the increasing emphasis on accountability at the federal level regarding OWQ’s federally funded water programs and the public’s strong desire to know whether environmental conditions in Indiana are getting better or worse.

The determination of statistically valid trends requires a long-term commitment to water quality monitoring in the same location(s). Trend monitoring is becoming increasingly difficult to sustain given the multiple monitoring objectives that OWQ must meet with its limited monitoring resources. Although the OWQ continues to collect data that can be used to determine trends at its fixed stations, it currently lacks the staff resources necessary to fully utilize these data and to explore different methods for determining trends.

The development of better trend information for surface waters is critical to OWQ's ability to describe water quality conditions in Indiana. OWQ is committed to conducting the monitoring necessary to do so. This *Strategy* reduces the frequency of monitoring at OWQ's fixed stations from monthly to quarterly in order to allow OWQ to redirect some of these resources to targeted monitoring needed to meet primary monitoring objectives but will continue to monitor most of the same locations for which long-term data exists. OWQ continues to seek the necessary funding for the staff resources required to analyze the resulting data for water quality trends.

3 MONITORING DESIGN

3.1 MONITORING AT SITES SELECTED BY PROBABILISTIC DESIGN

This monitoring design allows for a cost effective and statistically valid assessment of overall water quality of rivers and streams within each major river basin in Indiana. In the past, basin sampling has been conducted, such that, within a five-year time frame an assessment can be made for the entire state. The current probabilistic monitoring design follows a nine-year rotating basin approach (Figure 1). This approach divides Indiana into nine river basins, with each basin intensively sampled in one field season. The probabilistic design involves sample site selection using a stratified random distribution. Sites are selected by U.S. EPA National Health and Environmental Effects Research Laboratory in Corvallis, Oregon. This statistical method requires sampling 38-50 locations within a given basin. The results are extrapolated to characterize water quality conditions of the entire basin. In addition, over time, the data may be used to identify emerging trends in basin-wide water quality conditions. The probabilistic monitoring design gathers a variety of biotic and abiotic information including bacteriological, algal biomass, diatoms and soft algae, fish and macroinvertebrate community measures, in-stream and riparian habitat measures, and physical and chemical water chemistry parameters.

The probabilistic monitoring design provides the information needed to assess changes in Indiana aquatic ecosystems that affect aquatic life and to assure Indiana's rivers and streams support designated aquatic life use and support designated full body contact recreational use. More specifically, the results of this type of sampling provide information for OWQ's Integrated Water Monitoring and Assessment Report (IR), Total Maximum Daily Load (TMDL)

development, development of nonpoint source plans, and some types of trend analyses. Data collected using a probabilistic design may also be used to identify potential compliance issues which may need further sampling to investigate. Probabilistic nutrient sampling provides data to help implement OWQ's Nutrient Criteria Development Plan, an important component of U.S. EPA's nutrient criteria mandate to states. Various outside organizations, contractors, and government agencies also utilize probabilistic data.

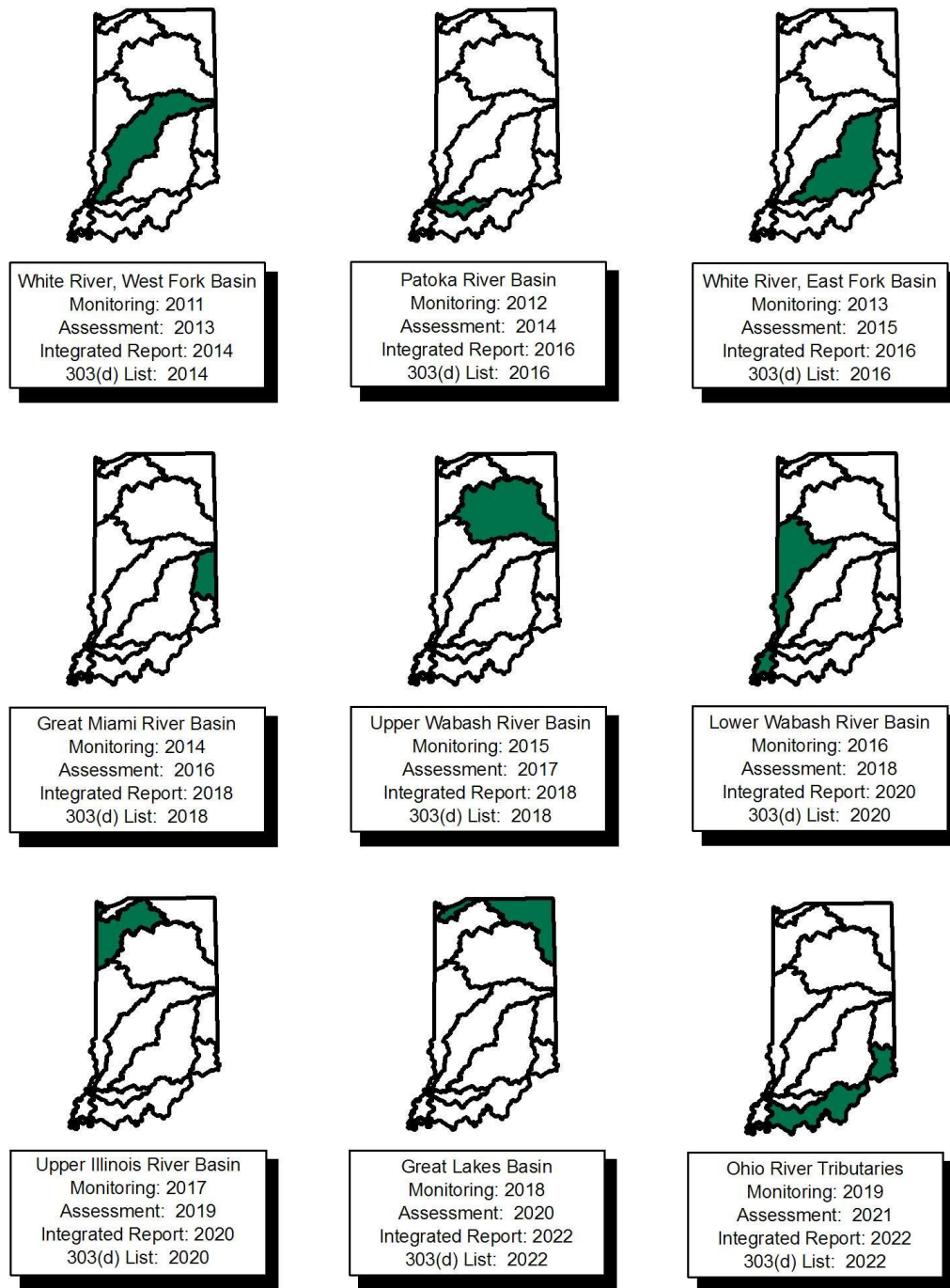


Figure 1: IDEM's nine-year rotating basin probabilistic monitoring schedule, which supports OWQ's CWA 305(b) assessments, 303(d) listing and Integrated Reporting processes.

3.2 MONITORING AT FIXED STATIONS

This program provides basic ambient water quality data for assessment of the major rivers of Indiana. IDEM's statewide Fixed Station Monitoring Program was established in 1957 with 49 sites. Since that time, sampling has increased to 161 sites statewide (Figure 2).

OWQ's fixed station monitoring activities provide data that can be used to determine long-term water quality trends and for CWA assessments and TMDL development. OWQ's National Pollutant Elimination Discharge System (NPDES) Program also uses data collected at fixed stations.

Source water monitoring is conducted at a subset of fixed station sites, usually sites at or near municipal water intakes. These sample sites were selected to encompass a statewide representation of major rivers and streams, and those municipalities relying on Lake Michigan for drinking water.

Bacteriological sampling is performed at sites in the immediate Indianapolis area and at three Lake Michigan sites as sample holding times allow. Also, selected sites are sampled monthly for radiological parameters to monitor certain areas of Indiana in support of the Indiana State Department of Health (ISDH) Radiochemistry Laboratory for the Indiana Department of Homeland Security Radiological Emergency Preparedness Program.

When the Fixed Station Program began, sites were monitored biweekly. Later, as the number of sites increased, monitoring frequency was reduced to monthly sampling. With this *Strategy*, fixed stations will be monitored quarterly in order to reallocate much needed resources to targeted monitoring. Quarterly sampling will continue to provide a comprehensive data set for valid statistical trend analyses. One of the concerns expressed during strategy discussions was the impact that a reduction to quarterly sampling would have on OWQ's ability to use fixed station data to determine trends. It was determined that although this change will result in lower resolution in the data set and thus less statistical rigor to any trend analyses that are conducted, quarterly samples will still allow for some types of trend analyses and will capture important seasonal changes that can affect the variability of aquatic systems.

The NPDES Program was consulted on the change in frequency of monitoring as fixed stations because the program relies on the total metals data collected at Fixed Station to develop permits. The NPDES Program did not anticipate any problems with this change. During this discussion, it was also determined that OWQ's NPDES program would benefit from a more comprehensive picture of total metals concentrations across the entire state, which would help to provide the representative background data needed to develop permits. Current fixed station locations may provide some of the data necessary to develop this. However, targeted

sampling for total metals at other locations in areas where the NPDES may be developing permits would be very beneficial.

The Watershed Assessment and Planning Branch (WAPB) plans to work with the NPDES program to determine the extent to which this need can be met through the resources made available by the changes proposed in this *Strategy*. Any monitoring activities undertaken for this purpose will be described in its next scheduled revision in 2013.

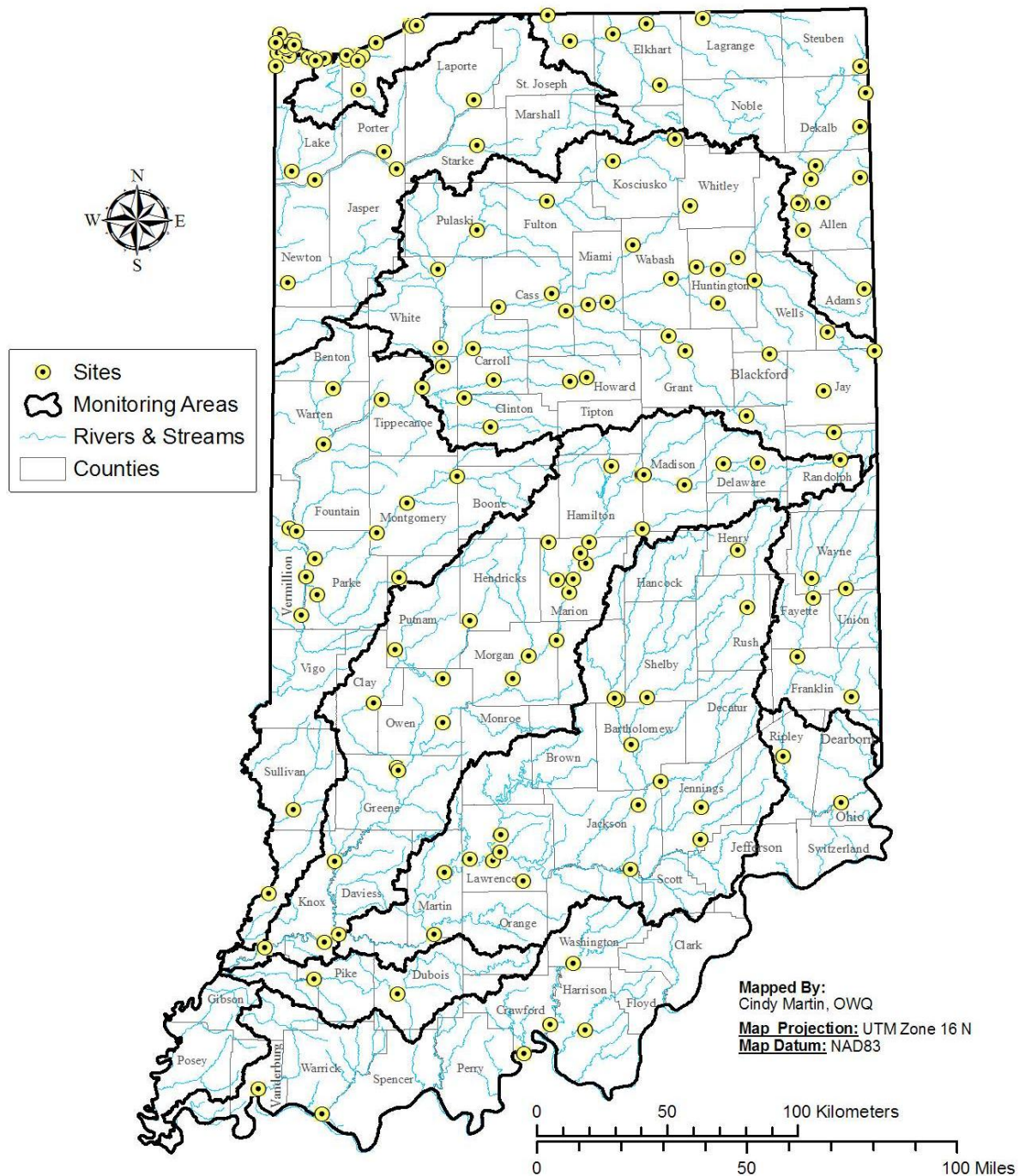


Figure 2: Map of IDEM's 161 fixed stations.

3.3 MONITORING AT TARGETED LOCATIONS

OWQ's targeted monitoring designs provide the primary data used to meet a number of the primary monitoring objectives identified in Table 1. Sampling occurs on different geospatial scales from entire basins to small watersheds. The sampling site selection is what makes this

type of sampling different from others listed in the *Strategy*. Sites and study areas are specifically selected based on known impairments, historical information, permitted dischargers, land use, watershed group focus areas, and other factors relevant to the monitoring objective for which the monitoring is to be conducted. Sampling projects and sites change annually and may occur anywhere in the state, depending on their specific monitoring objectives. The targeted monitoring design allows for gathering a variety of biotic and abiotic information including bacteriological, fish and macroinvertebrate community measures, fish and sediment contaminant levels, in-stream and riparian habitat measures, and physical and chemical water chemistry parameters.

Targeted monitoring designs provide the information needed to assess changes in Indiana aquatic ecosystems that affect aquatic life and to assure Indiana's rivers and streams support designated aquatic life use and support designated full body contact recreational use. More specifically, the results of this type of sampling provide information for the Integrated Report, TMDL development, data for public health advisories, measurement of CWA program performance improvements, and implementation of nonpoint source watershed management plans. In addition, the targeted monitoring design may be used to determine compliance with permits.

3.3.1 BASELINE MONITORING FOR WATERSHED PLANNING

Baseline monitoring is an intensive targeted watershed design that characterizes the current condition of a watershed. This type of monitoring provides valuable data for the purposes of watershed planning and which allows for future comparisons to evaluate changes in the water quality within the watershed(s) studied. Selecting a spatial monitoring design with sufficient sampling density to accurately characterize water quality conditions is a critical step in the process of developing an adequate local scale watershed study.

For its baseline studies, OWQ will use a geometric site selection process in order to get the necessary spatial representation of the entire study area. Sites within a watershed are selected based on a geometric progression of drainage areas starting with the area at the mouth of the mainstem stream and working upstream through the tributaries to the headwaters (sites ≥ 5 square miles). Monitoring sites are "snapped" to the nearest bridge.

This approach selects sampling sites in a semi-random fashion and according to the stratification of available stream and river sizes based on drainage area. The design is applied within single 10-digit Hydrologic Unit Code (HUC) or multiple 10-digit HUCs in order to fulfill the data needs at the scale at which watershed management is generally being conducted.

Study areas are selected based upon successful grant requests from local watershed groups. The processes for determining which watershed groups receive this monitoring assistance and for coordination with those that do are still being developed. It is anticipated that these studies will vary somewhat from year to year based on input from the watershed groups and the scale of their watershed planning effort. Generally, the baseline monitoring conducted by the WAPB will provide physical, chemical, and bacteriological data collected monthly for one year at all sites in the watershed(s) and biological data collected once per year at a subset of those sites.

It is anticipated that the water quality data collected through the WAPB baseline monitoring will provide the information that local water quality managers need to characterize the watershed, identify sources of impairment, and designate critical areas for their watershed management plan enabling them to make valid and informed watershed management decisions.

3.3.2 MONITORING TO IDENTIFY IMPROVEMENTS IN WATER QUALITY

Monitoring to identify improvements in water quality will be conducted in areas where there is reason to believe improvements may have occurred as a result of activities that may have a mitigating effect on water quality impairments identified on the state's 303(d) List of Impaired Waters.

Generally, study areas are selected based on where watershed management plans have been implemented and where the best management practices are most likely to have had sufficient time to have a measurable effect on water quality.

These studies will be conducted at the 12-digit HUC scale, which is consistent with the scale at which many OWQ-funded watershed plans now being implemented were developed. The specific parameters to be monitored and the number of sampling sites will vary depending on the type and spatial extent of the original impairment. Each 12-digit HUC may include up to 20 sampling sites which may be sampled for general chemistry and nutrients, bacteria, and/or fish community depending on the type of impairment(s) identified.

The number of samples collected at each site will be consistent with the minimum data requirements described in IDEM's Consolidated Assessment and Listing Methodology (CALM) (Appendix 2) for the listing and delisting of impairments on the 303(d) list. Sampling frequency for a given parameter will be similar to that of other monitoring programs for which the parameter is monitored.

3.3.3 MONITORING TO SUPPORT TMDL DEVELOPMENT

The targeted monitoring used to support TMDL development for waters identified on the state's 303(d) list is very similar to that used to identify improvements in water quality. Watersheds are selected for TMDL development based on a variety of factors including the type and number of impairments and whether or not there is an active watershed group that may be able to implement the TMDLs recommended in the report once it's developed.

Monitoring for the purposes of TMDL development is conducted at the 10-digit HUC scale. OWQ employs a watershed approach to TMDL development. Therefore, this monitoring is conducted throughout the watershed. Generally, a TMDL project will include two 10-digit HUCs, each of which may include up to 20 sampling sites which may be sampled for general chemistry and nutrients, bacteria, or both depending on the impairment(s) for which the TMDLs are being developed.

As with its targeted monitoring approach to identifying improvements in water quality, the number of samples collected at each site will be consistent with the minimum data requirements described in IDEM's CALM, and sampling frequency for a given parameter will be similar to that of other monitoring programs for which the parameter is monitored.

3.3.4 MONITORING TO SUPPORT DEVELOPMENT OF PUBLIC HEALTH ADVISORIES

Contaminants Monitoring – Fish tissue contaminant analysis is a widely used method of monitoring and assessing environmental contaminants and their bioavailability. Concentrations of some contaminants may be greater in tissues than in water because of bioconcentration, bioaccumulation, or biomagnification. Tissue contaminant monitoring, when part of an integrated multi-media monitoring program, gives insight into exposure levels and allows IDEM to better understand the complexities of contaminant distribution, fate, and effects. Fish tissue contaminant monitoring began in the late 1970s in cooperation with U.S. EPA. A monitoring network was established, consisting of 23 core sites, which were sampled biennially. In 1997, the rotating basin approach was adopted for fish tissue monitoring. Using this approach, all core sites within a given basin are sampled once every five years. In addition to core sites, other sites are monitored based on historical environmental problems, public access, use for fishing, and recommendations made by other agencies and entities. In all, approximately 30 to 35 sites are sampled each year with an average of six fish tissue samples collected per site. Most samples are prepared for edible portion. Samples are taken from fish that feed at all depths of the water, including predatory and bottom-feeding species. To maintain data resolution, monitoring will continue to follow the five-year rotating basin approach.

The current monitoring program includes rivers, streams, inland lakes and reservoirs, and Lake Michigan. Historically the Great Lakes National Program Office has monitored Lake Michigan for contaminant trends in salmonid sport fish. This monitoring was discontinued in 2007 at which time IDEM and the Indiana Department of Natural Resources (IDNR) collaborated to continue the monitoring necessary to assess fish tissue contaminant levels of Lake Michigan salmonid sport fish species.

Sediment sampling has been conducted in conjunction with fish tissue sampling in order to establish possible contaminant sources. Bio-accumulating contaminants in sediments are strongly associated with levels found in fish and can aid in determining the potential origins and extent of contamination. Sampling targets depositional areas for fine silt and organic deposits. Sediment sampling is not currently being conducted due to resource constraints. However, OWQ retains the ability to sample this matrix on an as-needed basis.

Cyanobacteria and Microcystin Monitoring – Cyanobacteria are common constituents of algal communities in lakes and many are known to produce potent toxins, which are now recognized as a potentially serious threat to human health. Microcystin is the cyanotoxin most commonly monitored. In 2010, IDEM began a targeted monitoring effort to gain a better understanding of the prevalence, extent and magnitude of blue-green algae populations and levels of microcystin toxins in Indiana lakes and reservoirs. Monitoring is conducted statewide at 10 public lakes on a monthly basis from June through September. Sampling frequency is increased to biweekly for lakes where cyanobacteria densities are found to be greater than 100,000 cells per milliliter, as recommended by the World Health Organization. Lakes and reservoirs are selected for monitoring based on having public recreation and swimming beaches and known or suspected blue-green algae production.

3.3.5 SPECIAL STUDIES

Monitoring Assistance Requested by Other IDEM Program Areas – Special Studies are conducted for the purposes of providing monitoring assistance to other IDEM program areas when needed. Special Studies are by nature very individualized due to the variety of reasons for which they may be requested. The targeted monitoring approaches needed to meet these monitoring objectives vary significantly in terms of the number and location of sampling sites, the number and type of samples needed, the media to be sampled and the parameters for which they are analyzed. In order to accommodate these needs, OWQ has developed a Survey Request Form (Appendix 4) which can be utilized by other branches or sections to request monitoring and assessment assistance. When a Survey Request Form is received from an Agency program area, a meeting with monitoring staff and management from the WAPB and the program requesting the assistance will be held to discuss the needs and a priority will be

placed on the requested project based on available resources and OWQ needs. If necessary, staff from the program requesting assistance may be asked to contribute some resources to the sampling effort (e.g. vehicles, staff, etc.).

Based on lessons learned from previous experience, OWQ has determined that to better accommodate requests for Special Studies, particularly given the logistical complexities associated with this revised *Strategy*, a documented process for coordination of such studies is needed. The WAPB plans to develop a Standard Operating Procedure (SOP) for this purpose as time allows.

Source Identification Studies – Source Identification Studies were first implemented with the 2006-2010 *Strategy* and were designed to more accurately identify sources of chemical and bacteriological impairments identified through OWQ’s CWA 305(b) water quality assessments. In many cases, sufficient data to identify the sources of these impairments is lacking. The source identification process emphasizes evaluation of background information to identify gaps in data and designs case-specific studies to collect data necessary to identify pollution sources. The memos developed through this process provide evidence and justification for source identification findings which are substantiated with data tables, maps, graphs, photos, and various informational sources.

These studies have since been virtually eliminated due to reductions in the number of staff available to do this work. And, while for the 2011-2019 *Strategy* other monitoring activities have necessarily taken precedence, Source Identification Studies may allow OWQ to more accurately categorize impairments on Indiana’s 303(d) list. These studies have the potential to reveal where the sources driving a given impairment cannot be addressed by a TMDL and where, as such, the impairment does not should be placed on the 303(d) list.

Although Source Identification Studies have been discontinued for the time being, based on their potential use in more accurately characterizing impairments they remain a part of this *Strategy*. In the future, the WAPB plans to work with U.S. EPA to determine whether the reports produced through previous studies provide sufficient documentation to support the removal of impairments from the 303(d) list where appropriate. If it is possible to use previous Source Identification Studies in this way, the WAPB will reconsider whether resources should be allocated again to this type of monitoring in the future at its next scheduled review of this *Strategy*.

3.3.6 LAKES MONITORING

The CLP is administered for IDEM by IU/SPEA through a grant from OWQ’s Nonpoint Source Program and includes two primary but different monitoring components. IU/SPEA staff and

students conduct the majority of the monitoring for the CLP and administer a volunteer monitoring program through which additional monitoring is conducted by a corps of trained citizen volunteers.

Monitoring Conducted by IU/SPEA Staff and Students – Lakes monitored by IU/SPEA are selected for sampling from a population of approximately 400 lakes throughout Indiana which are greater than five acres in surface area and which have a publicly accessible boat launching area. Prior to 2010, decisions regarding the specific lakes to be sampled from this population were based primarily on logistical considerations. In 2010, the program began using a randomized sampling approach to select lakes from this population to monitor in order to explore additional statistical assessment methods for lakes, which would augment the trend and trophic status assessments conducted by IDEM. Prior to approving of this change in approach, IDEM worked with IU/SPEA to ensure that trend assessments can continue despite the shift to a randomized approach to monitoring lakes, particularly given the large number of lakes that have been monitored to date through the CLP, which dates back to 1989.

IU/SPEA samples approximately 80 lakes per year, and volunteers monitor approximately 100 more annually. Monitoring conducted by IU/SPEA staff and students occurs in July and August of each year to coincide with the period of thermal stratification and to capture the period of poorest annual water quality condition in lakes. In addition to collecting water samples, dissolved oxygen and temperature are measured at one-meter intervals from the surface to the bottom of each lake to provide a profile of stratification for each lake.

As with IDEM's CWA 305(b) assessments and 303(d) listing processes, CWA section 314 assessments can be made with data collected at any lake regardless of the methods for site selection as long as the monitoring design includes all the core parameters needed to calculate the Indiana Trophic State Index (ITSI) described in the CALM (Appendix 2).

In 2010, OWQ used CWA Supplemental 106 funds to contract with the CLP to collect additional samples for cyanobacteria testing at all the lakes monitored during its regular sampling season. Unlike the cyanobacteria testing conducted for the purposes of developing public health advisories, this sampling effort is intended to provide valuable information for determining the environmental variables associated with blue-green algal blooms and microcystin production.

Monitoring Conducted by Citizen Volunteers – The primary objective of the volunteer component of the Clean Lakes Program is to engage Indiana's citizens in gathering quality scientific data from both public and private lakes. In this program, volunteers are trained to monitor water clarity at more than 100 lakes around the state.

CLP volunteers take Secchi disk measurements every two weeks at the same site in the lake each time, generally over the deepest part of the lake. They are also asked to note the color of the lake and to evaluate the recreational potential and physical appearance of the lake. Volunteers submit their data to IU/SPEA using pre-paid postage cards or may enter their data electronically on the CLP website. The monitoring conducted by CLP volunteers is targeted to their particular lake(s) of interest and may include both public and private lakes.

In addition to their regular monitoring, approximately 40 of the more experienced volunteers sample *Chlorophyll a* and total phosphorous once a month during the summer, typically May through August. Samples are frozen and shipped overnight to IU/SPEA for analysis by CLP staff.

3.3.7 GROUND WATER MONITORING

OWQ is employing a phased approach to its ground water monitoring. In these early stages of the Ground Water Monitoring Network (GWMN), the focus continues to be on developing a statistically rigorous baseline characterization of ground water quality throughout the state. OWQ has determined that developing this baseline will require approximately five years of sampling at numerous locations throughout Indiana. To date, OWQ's GWMN has conducted ground water monitoring for almost three years.

In 2010, the GWMN consisted of 313 sites including 153 private/residential wells and 160 public water supply wells (Figure 3). Public water supply wells include sites such as schools, day cares, churches, etc. The number of sites is not static, and may vary based on sampling results, additional sites selected, and the availability of resources.

Potential sampling locations were initially identified based on a review of well logs obtained from the IDNR. Sampling locations were selected with the goal of obtaining adequate coverage of the entire state with generally one site in every county in the state. Site selection is further optimized using geographic information systems (GIS) software, which allows OWQ to leverage its efforts with existing wells such as those used by the U.S. Geological Survey National Water-Quality Assessment Program and Indiana Geological Survey (IGS). Existing wells originally installed for OWQ's pesticide monitoring project in 1996 are also sampled. OWQ's Ground Water Program, which resides in the Drinking Water Branch (DWB), works with the WAPB's surface water monitoring programs to coordinate their respective monitoring efforts where possible in order to provide data necessary to better understand surface water and ground water interactions throughout the state.

Sampling for the GWMN may also be conducted at private residential wells to ensure adequate coverage when no other existing wells are available. In these cases, a form is sent to the resident or responsible party requesting permission to sample the well. Sampling of private

residential wells is also conducted when requested by the homeowner through the Citizen's Complaint Monitoring Program. Sampling through this program meets two primary monitoring objectives. Homeowners receive information regarding the quality of the drinking water drawn from their wells, and the data collected provides additional information for OWQ use in characterizing ground water quality, particularly in areas not served by a PWS.

Ground Water Monitoring Network Sites

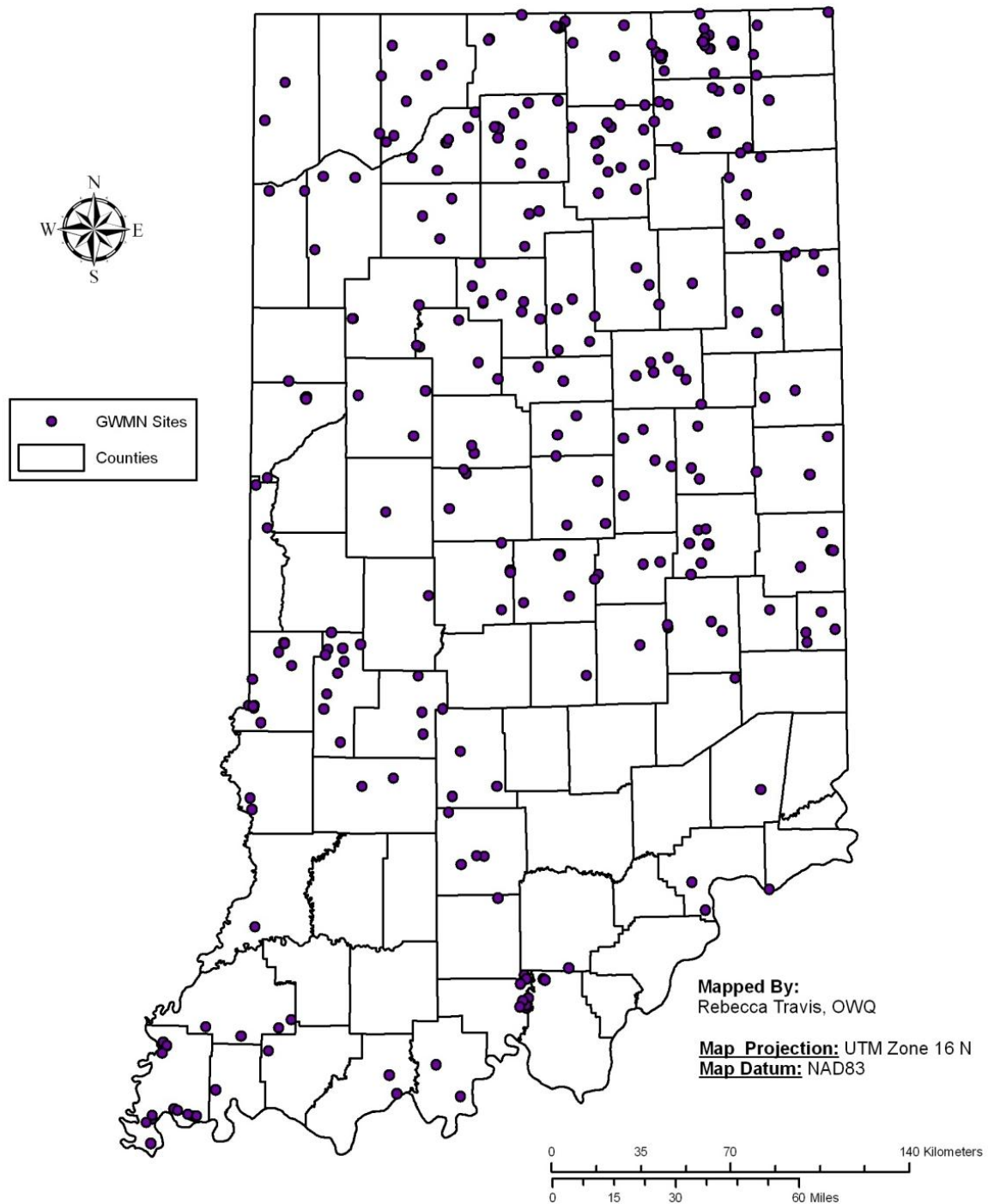


Figure 3: Sites sampled for the Ground Water Monitoring Network.

All sampling locations are assessed for potential sources of contamination and geologic site conditions. With regard to geologic conditions, sites are related to Indiana's hydrogeologic terrain and settings, which are based on a classification scheme created by the IGS to facilitate interpretation, movement, and sensitivity to surficial contamination of ground water (Fleming, 1995). OWQ anticipates that with five years of sampling, it will be possible to develop relationships between site location, hydrogeologic setting and ground water quality.

Sites are sampled once a year. OWQ is currently reviewing the logistics of its ground water sampling efforts in order to determine if quarterly sampling at a subset of these sites is possible. It is anticipated that quarterly sampling will achieve greater temporal consistency and will help to determine optimal sampling periods to facilitate more accurate and comprehensive characterization of seasonal variability in ground water quality. The seasonal component is particularly important to understanding the extent to which surface applications of fertilizers and pesticides may be impacting ground water quality both in terms of timing and location.

Once a statistically rigorous baseline characterization of ground water quality is developed for Indiana, the next phase of OWQ's ground water monitoring efforts will begin. During this phase, the focus will shift to those areas found to be impacted by contamination and on other drinking water concerns that may be naturally occurring (e.g. arsenic). Currently, the plan is to increase the number of sites in these areas to provide sufficient information to determine sources and extent of contamination and of any naturally occurring substances that may be impacting Indiana's drinking water resources.

3.3.8 WETLANDS MONITORING

For many years U.S. EPA has urged Indiana to assess and monitor its wetland resources. Unfortunately, both resource constraints and other Agency priorities have prevented IDEM from developing a wetland-specific monitoring program.

The 2006-2010 *Strategy* proposed a comprehensive monitoring strategy for wetlands that would achieve consistency with U.S. EPA guidance. The plan was to first complete a rapid classification system for isolated wetlands, which was required by state legislation. The work on developing a more comprehensive monitoring strategy for wetlands would follow.

Development of this monitoring strategy was to start with the completion of a Tier 1 assessment using remote methods to determine the abundance of wetland resources in Indiana. The next step would develop the methods necessary for tracking gains and losses in wetlands, the services they provide, and integrity and to build a database to house this information. To complete Tier II assessment, OWQ proposed to develop and implement a rapid ground assessment method to verify and refine the information gained from the use of remote

methods of assessment. Then a comprehensive ground assessment method would be developed to further refine the information gathered from Tier 1 and tier 2 assessments.

In the 2006-2010 *Strategy*, OWQ estimated that such a wetland monitoring strategy would require more than \$900,000 and at least six full time staff to develop and implement over a five-year cycle. Given the significant costs associated with developing and implementing the wetlands monitoring strategy proposed, in developing this *Strategy* OWQ has found it necessary to re-evaluate this work within the context of all the other monitoring objectives it must meet with increasingly limited resources going forward. It was determined that given present resource constraints and agency priorities, it is unlikely that IDEM will develop the wetland-specific monitoring program proposed in the 2006-2010 *Strategy*. At this point OWQ is now exploring more cost effective alternatives that will build on the progress made to date.

Since the 2006-2010 *Strategy* was developed, OWQ has completed a rapid classification system for isolated wetlands, which provides a rapid on-the-ground assessment methodology for determining a given wetland's class for regulatory purposes.

In 2009, OWQ also funded a project to update Indiana's National Wetlands Inventory (NWI) maps using high resolution aerial photography for Indiana, which became available in 2005. This photography was acquired in the spring before the trees had leaves, and was collected at one-meter resolution true color with some higher resolution counties. This work provides a good foundation for Tier 1 assessments.

Currently, OWQ is exploring the possibility of building on this work by developing a windshield survey method with the goal of further refining the revised NWI maps to determine the presence/absence of Indiana's wetland resources mapped at high resolution, their abundance, distribution and type. This work would result in more NWI accurate maps for use by OWQ's regulatory and non-regulatory programs that use them. Such surveys would necessarily have to be completed by staff as time allows, but it may be possible to incorporate this work into the compliance monitoring that OWQ's 401 Water Quality Certification Program staff routinely perform. As part of the 401 Water Quality Certification process, OWQ staff spend a great deal of their time in the field visiting proposed wetland project sites and, depending on their project loads, might be able to conduct a survey in the watershed(s) in which the project is located.

If OWQ develops a method for windshield surveys and is able to incorporate this additional work into its compliance monitoring activities, a database will be needed to store the information obtained. The 2006-2010 *Strategy* proposed the development of a database that would house compliance-related information that might also be used to maintain other information pertinent to the management of Indiana's wetland resources. At the time, it was estimated that development of this database would cost approximately \$80,000. For the

development of this *Strategy*, including this cost in the overall budget for this *Strategy* would be premature as OWQ has only recently begun to explore the possibility of conducting windshield surveys. It is mentioned here only to illustrate that there is a financial cost in addition to the staff resources needed to implement windshield survey methods.

4 CORE AND SUPPLEMENTAL WATER QUALITY INDICATORS

Core and supplemental water quality indicators include physical, chemical, toxicological, biological, and ecological indicators that which can be used to meet IDEM's water quality monitoring objectives. U.S. EPA defines "core" indicators specifically as those which can be used to assess water quality standards (WQS) attainment through a state's designated use assessment under CWA Section 305(b) and "supplemental" indicators as those used to address more specific questions such as determining the source of impairment, or screening for a specific pollutant of concern (U.S. EPA, 2003).

For the purposes of this *Strategy*, OWQ defines core and supplemental indicators differently, more broadly within the context of water quality monitoring objectives. For example, while pathogen indicators are useful in determining whether a waterbody supports recreational uses, they have no value in determining whether or not fish caught from that same waterbody may be safely consumed. Designated use assessments and providing data for the development of fish consumption advisories are both examples of different, but primary water quality monitoring objectives that IDEM's *Strategy* is intended to address. Thus, OWQ considers "core" indicators to be those which are critical to meeting the specific water quality monitoring objective for which they are monitored, while "supplemental" indicators are additional indicators that provide valuable information but which are not necessary in order to meet the water quality monitoring objective.

This section describes core and supplemental indicators used by IDEM, how they are linked to the monitoring designs described in Section 3, and how they facilitate meeting the monitoring objectives identified in Section 2 of this *Strategy*.

4.1 PHYSICAL AND CHEMICAL INDICATORS MEASURED IN THE FIELD

Core and supplemental indicators measured in the field are shown in Table 2. Core indicators of in-situ water quality conditions are measured using a calibrated multi-probe unit. Field verification of multi-probe measurements are conducted weekly by each sampling team. When measurements with the multi-probe indicate the potentially impaired conditions, supplemental measurements of dissolved oxygen are made using the Winkler titration method, and supplemental measurements of pH and temperature are taken with portable pH, temperature

and turbidity meters. Supplemental measurements of ammonia may also be collected with portable ammonia kits when conditions warrant.

Table 2: Core and supplemental indicators of physical surface water quality conditions, the monitoring objectives they are intended to meet and the sampling approaches under which they are monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Discharge (stream flow)	C, F	G		X	X
Dissolved Oxygen	A,B,C,D,E,F,G,J,K		X	X	X
Percent Saturation	A,B,C,D,E,G,J,K	F	X	X	X
Conductivity	A,B,C,D,E, G,J,K	F	X	X	X
pH	A,B,C,D,E,F,G,J,K		X	X	X
Turbidity	A,B,C,D,E G,J,K	F	X	X	X
Temperature	A,B,C,D,E G,J,K	F	X	X	X
Oxidation-reduction potential (Eh)	I		X	X	
Ammonia	A,B,C,E,F,G,J,K,L,O		X	X	

4.2 CHEMICAL INDICATORS ANALYZED IN THE LABORATORY

The core and supplemental chemical in water samples collected for laboratory analysis are shown in Table 3. These indicators include general chemical parameters, nutrient parameters, and parameters, which are known to have toxic effects on aquatic organisms. Chemical indicators provide important information regarding the chemical constituents of the waterbody sampled and are used to 1) identify pollutants that may be present in the water column, and 2) the affect that chemical conditions may be impacting the aquatic community. Nutrient indicators are also critical for the development of nutrient criteria.

Table 3: Core and supplemental indicators of general chemical surface water quality conditions, the monitoring objectives they are intended to meet and the sampling approaches under which they are monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Alkalinity	F,G,J,K,O	C	X	X	X
Total Solids	G,J,K,O	C ,F	X	X	X
Suspended Solids	F,G,J,K,O	C	X	X	X
Dissolved Solids	G,J,K,O	F	X	X	X
Sulfate	A,B,CG,J,K,O	F	X	X	X
Chloride	A,B,C, ,G,J,K,O	F	X	X	X
Hardness	A,B,C,G,J,K,O	F	X	X	X
Total Kjeldahl Nitrogen (TKN)	E,F,G,J,K,L,O	F	X	X	X
Ammonia (NH ₃ -N)	A,B,C,E,F,G,J,K,L,O	F	X	X	X
Nitrate-Nitrite (NO ₂ +NO ₃)	A,B,C,E,F,G,J,K,L,O		X	X	X
Total Phosphorus	A,B,C,F,G,J,K,O		X	X	X
Total Organic Carbon (TOC)	G,J,K,O	F	X	X	X
Chemical Oxygen Demand (COD)	G,J,K,O	F	X	X	X
Total Metals	G,J,K,O	F			X
Dissolved Metals	A,B,C,E, G,J,K,O	F	X	X	X
Total Cyanide	G,J,K,O	F	X	X	X
Free Cyanide	A,B, C,G,J,K,O	F	X	X	X

4.3 BACTERIOLOGICAL AND TOXICOLOGICAL INDICATORS

Core and supplemental bacteriological and toxicological indicators are used to identify environmental conditions that pose a potential risk to human health.

4.3.1 BACTERIOLOGICAL INDICATORS

The bacteriological indicator shown in Table 4 is measured in surface water samples collected for laboratory analysis in order to determine the human health risks associated with exposure to pathogenic microbes present in the water.

Table 4: Core indicator of bacteriological water quality conditions that may pose a potential risk to human health, the monitoring objectives this indicator is intended to meet and the sampling approaches under which it is monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
<i>Escherichia coli</i>	A,B,C,F,G,H,J,O		X	X	X

4.3.2 ALGAL TOXINS

Cyanobacteria (blue-green algae) are common constituents of algal communities in surface waters. Many types of cyanobacteria are known to produce algal toxins, which pose a potentially serious threat to human health. However, much remains to be learned about the environmental conditions under which algal toxins are produced and the cumulative or synergistic effects of other irritants that may be present in surface waters. Additional factors include the varying sensitivities of humans and animals exposed to the toxins.

In 2010, OWQ began a pilot project to build the capacity internally for monitoring blue-green algal populations and toxin levels in Indiana's surface waters. This effort currently focuses on identification and enumeration of blue-green algae and analysis of microcystin toxin production, an important indicator of the potential human health risks associated with blue-green algae levels in recreational lakes and reservoirs (Table 5). This effort is expected to continue and may be expanded in the future as resources allow.

Table 5: Core indicators of the potential human health risks associated with algal levels in recreational lakes, the monitoring objectives they are intended to meet and the sampling approaches under they are monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Microcystin	E,H,L,O			X	
Cyanobacteria density	E,H,L,O			X	

4.3.3 FISH TISSUE AND SEDIMENT CONTAMINANTS

Bioaccumulative chemicals of concern are measured in the edible tissues of fish caught from surface waters to indicate the potential health risks associated with fish consumption. Sediment indicators augment this information. Both fish tissue samples and sediment samples are analyzed in the laboratory.

The fish tissue indicators in Table 6 are used to determine the risks associated with fish consumption and to calculate consumption rates that are safe. Many of these pollutants occur in such low concentrations in the water column that they are usually below analytical detection limits. However, over time, they may accumulate in fish tissue to levels that are easily measured. Therefore, fish tissue results may also be used as indicators of pollutants that may be present in the waterbody at very low levels that would not be detected in water samples.

Supplemental fish tissue indicators may be analyzed when industrial, municipal, or other pollution is suspected, or if a core indicator shows a certain type of impairment. Fish tissue sampling continues to evolve over time as public concerns regarding new and emerging contaminants in the environment grows. If OWQ decides in the future to investigate other contaminants of concern, the core and supplemental indicators identified in this *Strategy* will be modified accordingly.

Sediment sampling is conducted in conjunction with fish tissue sampling when analytical resources are available in order to determine possible contaminant sources. Bioaccumulating contaminants in sediments are strongly associated with levels found in fish and can aid in determining the potential origins and extent of contamination. Results for the sediment indicators shown in Table 7 are used to supplement the fish tissue information used to develop fish consumption advisories.

Table 6: Core supplemental indicators of bioaccumulative pollutants of concern in fish tissue, the monitoring objectives they are intended to meet and the sampling approaches under they are monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Total Polychlorinated Biphenyls (PCB)	A,B,H,O			X	
Metals*	A,B,H,O			X	
Organochlorine Pesticides*	A,B,H,O			X	
Polycyclic Aromatic Hydrocarbons*		A,B,H,O		X	
Polybrominated Diphenyl Ethers*		A,B,H,O		X	
PCB Congeners*		A,B,H,O		X	
Polychlorinated Dioxins and Furans*		A,B,H,O		X	
Semi-volatile organic compounds *		A,B,H,O		X	

*The specific parameters included in this group of indicators are identified in IDEM's quality assurance project plan for surface water monitoring (IDEM, 2004).

Table 7: Core and supplemental indicators of bioaccumulative pollutants of concern in sediment, the monitoring objectives they are intended to meet and the sampling approaches under they are monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Polycyclic Aromatic Hydrocarbons*		A,B,H,O		X	
Simultaneously Extracted Metals*		A,B,H,O		X	
Organochlorine Pesticides*		A,B,H,O		X	
PCB Aroclors*		A,B,H,O		X	
Semi-volatile organic compounds*		A,B,H,O		X	
Volatile organic compounds*		A,B,H,O		X	
PCB Congeners*		A,B,H,O		X	
Cyanide		A,B,H,O		X	

* The specific parameters included in this group of indicators are identified in IDEM's quality assurance project plan for surface water monitoring (IDEM, 2004).

4.4 BIOLOGICAL AND OTHER ECOLOGICAL INDICATORS

4.4.1 FISH COMMUNITY ASSESSMENT

OWQ conducts fish community sampling to determine the biological integrity of Indiana's rivers and streams. The Index of biotic integrity (IBI) is composed of 12 metrics that when analyzed together can be used to assess the community's species and trophic composition (feeding and reproductive guilds) and fish condition and health (Table 8). The total IBI score, integrity class and attributes help define fish community characteristics. Separate metrics have been developed based on drainage area for headwater streams (< 20 miles²), wadable rivers (20-1000 miles²), and great rivers (>1000 miles²). Additional scoring modifications exist for the Wabash River. All of the indicators shown in Table 8 are identified as "core" because they represent the metrics required for the calculation of the IBI.

Table 8: Core fish community indicators, the monitoring objectives they are intended to meet and the sampling approaches under they are monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Number of Species	A,B,F,G,L,O,P,Q		X	X	
Number of Native Species	A,B,F,G,L,O,P,Q		X	X	
Darter/Madtom/Sculpin Species Count	A,B,F,G,L,O,P,Q		X	X	
Number of Darter Species	A,B,F,G,L,O,P,Q		X	X	
Number of Minnow Species	A,B,F,G,L,O,P,Q		X	X	
% Large River Individuals	A,B,F,G,L,O,P,Q		X	X	
% Headwater Individuals	A,B,F,G,L,O,P,Q		X	X	
Number of Sunfish Species	A,B,F,G,L,O,P,Q		X	X	
Number of Centrarchid Species	A,B,F,G,L,O,P,Q		X	X	
Number of Salmonid Species	A,B,F,G,L,O,P,Q		X	X	
Number of Sucker Species	A,B,F,G,L,O,P,Q		X	X	
Number of Round-Bodied Sucker Species	A,B,F,G,L,O,P,Q		X	X	
Number of Sensitive Species	A,B,F,G,L,O,P,Q		X	X	
% Tolerant Individuals	A,B,F,G,L,O,P,Q		X	X	
% Omnivore Individuals	A,B,F,G,L,O,P,Q		X	X	
% Insectivore Individuals	A,B,F,G,L,O,P,Q		X	X	
% Pioneer Individuals	A,B,F,G,L,O,P,Q		X	X	
% Carnivore Individuals	A,B,F,G,L,O,P,Q		X	X	
Total Number of Individuals (CPUE)	A,B,F,G,L,O,P,Q		X	X	
Total Number of Individuals (CPUE) less gizzard shad	A,B,F,G,L,O,P,Q		X	X	
% Simple Lithophilic Individuals	A,B,F,G,L,O,P,Q		X	X	

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
% Individuals with Deformities, Eroded Fins, Lesions, Tumors	A,B,F,G,L,O,P,Q		X	X	

4.4.2 MACROINVERTEBRATE COMMUNITY ASSESSMENT

In addition to fish community sampling, OWQ also conducts macroinvertebrate community sampling to determine the biological integrity of rivers and streams. OWQ's Multi-habitat Macroinvertebrate Index of Biotic Integrity (mIBI) is composed of 12 metrics that measure taxa richness, feeding and habitat preferences and tolerance to environmental stressors (Table 9). The total mIBI score, integrity class and attributes help define macroinvertebrate community characteristics. All of the indicators shown in Table 9 are identified as "core" because they represent the metrics required for the calculation of the Multi-Habitat mIBI.

Table 9: Core macroinvertebrate community indicators, the monitoring objectives they are intended to meet and the sampling approaches under they are monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Number of Taxa	A,B,F,G,L,O,P,Q		X	X	
Number of Individuals	A,B,F,G,L,O,P,Q		X	X	
Number of Ephemeroptera, Plecoptera, Trichoptera (EPT) Taxa	A,B,F,G,L,O,P,Q		X	X	
% Orthocladinae and Tanytarsini	A,B,F,G,L,O,P,Q		X	X	
% Non-insects Minus Crayfish	A,B,F,G,L,O,P,Q		X	X	
Number of Diptera Taxa	A,B,F,G,L,O,P,Q		X	X	
% Intolerant Individuals	A,B,F,G,L,O,P,Q		X	X	
% Tolerant Individuals	A,B,F,G,L,O,P,Q		X	X	
% Predator Individuals	A,B,F,G,L,O,P,Q		X	X	
% Shredders and Scrapers	A,B,F,G,L,O,P,Q		X	X	
% Collector-Filterers	A,B,F,G,L,O,P,Q		X	X	
% Sprawlers	A,B,F,G,L,O,P,Q		X	X	

4.4.3 QUALITATIVE HABITAT EVALUATION INDEX

OWQ uses the Qualitative Habitat Evaluation Index (QHEI) to assess habitat quality at sites where the fish community and or resident macroinvertebrate community are sampled. The QHEI is a physical habitat index designed to provide an empirical, quantified evaluation of the general macrohabitat characteristics that are important to fish and macroinvertebrate communities. Habitat information is recorded and used to determine the score of six metrics describing the substrate, instream cover, channel morphology, bank erosion and riparian zone, pool/glide and riffle/run quality, and gradient (Table 10). The indicators identified as “core” represent the metrics required for the calculation of QHEI. Supplemental indicators are used to provide additional information that is not necessary for the calculation of the QHEI but is used to augment the information it provides.

Table 10: Core and supplemental habitat indicators, the monitoring objectives they are intended to meet and the sampling approaches under they are monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Substrate: Predominant Substrate in Pool and Riffle, Number of Substrates, % Total Substrates, Number of Best Substrate Types, Origin, Silt Cover, and Embeddedness	F,G,O,Q	A,B	X	X	
Instreams Cover: Type of Instream Cover, Amount of Instream Cover, % Total Instream Cover	F,G,O,Q	A,B	X	X	
Channel Morphology: Sinuosity, Development of Pool/Riffle/Run Habitats, Channelization, Stability,	F,G,O,Q	A,B	X	X	
Riparian Zone and Bank Erosion: Riparian Width, Floodplain Quality, Bank Erosion	F,G,O,Q	A,B	X	X	
Pool/Glide Quality: Maximum Pool Depth, Morphology of Pool vs. Riffle Width, Pool/Riffle/Run Current Velocity	F,G,O,Q	A,B	X	X	
Riffle/Run Quality: Riffle Depth, Run Depth, Riffle/Run Substrate, Riffle/Run Embeddedness	F,G,O,Q	A,B	X	X	
Gradient: Gradient (feet/mile), Drainage Area (square miles)	F,G,O,Q	A,B	X	X	
Major Suspected Impacts	Q	A,B,F,G,O	X	X	
Subjective and Aesthetic Rating		A,B,F,G,O,Q	X	X	
Canopy Cover		A,B,F,G,O,Q	X	X	
% Riffle		A,B,F,G,O,Q	X	X	
% Run		A,B,F,G,O,Q	X	X	
% Glide		A,B,F,G,O,Q	X	X	
% Pool		A,B,F,G,O,Q	X	X	
Stream Drawing		A,B,F,G,O,Q	X	X	

4.4.4 ALGAL COMMUNITY ASSESSMENT

Algal communities are sampled from lakes, rivers, and streams to fulfill different monitoring objectives. OWQ's algal monitoring focuses on two important components of algal biomass in surface waters, *Chlorophyll a*, soft algae, and diatoms (Table 11). *Chlorophyll a* is collected as a measure of algal biomass from both phytoplankton and periphyton, which is needed for the development of nutrient water quality criteria. Diatom community sampling provides the information necessary to develop algal metrics to be used as a line of evidence in the development of nutrient criteria for rivers and streams.

In an effort to develop algal metrics for Indiana streams and rivers, IDEM will include algal identification and enumeration as part of its probabilistic sampling activities. Studies have shown that algal community metrics are a more precise indicator of nutrient enrichment compared to other response variables. One goal of this monitoring is to determine if periphyton diatom data will indicate a stronger correspondence with nutrients than fish or invertebrate metrics. Using data collected from this project, IDEM intends to develop algal metrics which will be used to support nutrient criteria being developed for Indiana's rivers and streams.

Table 11: Core and supplemental indicators of the presence of algal communities in surface waters, the monitoring objectives they are intended to meet and the sampling approaches under they are monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Chlorophyll a	A,B,E,L,O		X		
Diatoms	E, L		X		

4.4.5 INDIANA TROPHIC STATE INDEX

Lakes sampling uses the Indiana Trophic State Index (ITSI) to assess the trophic status of Indiana's lakes and reservoirs. The ITSI is a classification system designed to rate individual lakes, and reservoirs based on the amount of algal productivity occurring in the water. The ITSI consists of 11 physical, chemical, and biological metrics, which when combined provide important information regarding both the trophic status of the lake sampled and the degree to which human activities may be influencing it. The indicators identified as "core" in Table 12 represent the metrics required for the calculation of the ITSI. Supplemental indicators shown are used by IU/SPEA to conduct additional analyses.

Table 12: Core and supplemental indicators of lake trophic status, the monitoring objectives they are intended to meet and the sampling approaches under they are monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Total Phosphorus	A,B,D,E,O	F		X	
Soluble Phosphorus	A,B,D,E,O	F		X	
Organic Nitrogen	A,B,D,E,O	F		X	
Nitrate	A,B,D,E,O	F		X	
Ammonia	A,B,D,E,O	F		X	
Dissolved Oxygen (% saturation at 5 foot depth)	A,B,D,E,O	F		X	
Dissolved Oxygen (% of measured water column with at least 0.1 ppm)	A,B,D,E,O	F		X	
Light Penetration	A,B,D,E,O	F		X	
Light Transmission	A,B,D,E,O	F		X	
Total Plankton	A,B,D,E,O	F		X	
Blue-green Algae %	A,B,D,E,O	F		X	
Alkalinity		A,B,D,E,F,O		X	
Conductivity		A,B,D,E,F,O		X	
Total Suspended Solids		A,B,D,E,F,O		X	
Volatile Suspended Solids		A,B,D,E,F,O		X	
Land Use		A,B,D,E,F,O		X	
1% Light Level		A,B,D,E,F,O		X	
Chlorophyll <i>a</i>		A,B,D,E,F,O		X	
pH		A,B,D,E,F,O		X	
Temperature Profile		A,B,D,E,F,O		X	

4.5 GROUND WATER INDICATORS

The core ground water indicators monitored through OWQ's GWMN include organic and inorganic parameters for which maximum contaminant levels exist and which are most likely to affect surface water quality in streams impacted by ground water and surface water interactions (Table 13). Supplemental indicators are selected on a site-specific basis depending on the particular needs of the study to be undertaken. Supplemental indicators are usually monitored in areas known or suspected to be impacted by specific pollutants or other substances.

Table 13: Core and supplemental indicators of ground water quality, the monitoring objectives they are intended to meet and the sampling approaches under they are monitored.

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Dissolved Metals*	A,B,I,J,O			X	
Bromate	A,B,I,J,O			X	
Bromide	A,B,I,J,O			X	
Chlorate	A,B,I,J,O			X	
Chloride	A,B,I,J,O			X	
Chlorite	A,B,I,J,O			X	
Fluoride	A,B,I,J,O			X	
Nitrogen, Nitrate	A,B,I,J,O			X	
Phosphorous, Ortho	A,B,I,J,O			X	
Sulfate	A,B,I,J,O			X	
Nitrate + Nitrite	A,B,I,J,O			X	
Dibromo-3-chloropropanes*		A,B,I,J,O		X	
Chlorinated Acids*		A,B,I,J,O		X	
Volatile Organic Compounds*		A,B,I,J,O		X	
Phosphonic acid (AMPA)		A,B,I,J,O		X	
Phosphonic acid (Glyphosate)		A,B,I,J,O		X	
Unregulated Pesticide Degradates*		A,B,I,J,O		X	
Turfgrass Pesticides*	A,B,I,J,O			X	

Indicator	Monitoring Objective(s) from Table 1		Probabilistic	Targeted	Fixed Station
	Core	Supplemental			
Synthetic Organic Compounds*	A,B,I,J,O			X	
Alkalinity	A,B,I,J,O			X	

*The specific parameters included in this group of indicators are identified in OWQ's standard operating procedures for the GWMN (IDEM, 2010).

5 QUALITY ASSURANCE

U.S. EPA requires that any state delegated with the authority to implement federal programs and receiving federal funds must have a quality management plan (QMP). A QMP ensures the proper planning, implementation, and assessment of the state's quality assurance (QA) and quality control (QC) measures. IDEM's QMP was approved by U.S. EPA in 1999. The QMP was revised in 2005 to serve as an Agency-wide umbrella structure that contains quality system components including sub-QMPs for OWQ's Watershed Assessment and Planning Branch (WAPB) (previously known as the Assessment Branch) and the Drinking Water Branch (DWB). OWQ's surface water monitoring programs are covered by the sub-QMP for the WAPB (IDEM, 2008) and are described in greater detail in the branch's *Quality Assurance Project Plan for Surface Water Quality Monitoring and Total Maximum Daily Load (TMDL) Program* (IDEM, 2004). The ground water monitoring activities discussed in this *Strategy* are covered in sub-QMP for the Drinking Water Branch (IDEM, 2009).

5.1 QUALITY ASSURANCE OF OWQ'S SURFACE WATER MONITORING PROGRAMS

OWQ's quality assurance project plan (QAPP) for surface water quality monitoring provides a measurement of environmental data quality and ensures that the data collected are validated and legally defensible for use in regulatory decision-making processes.

The surface water QAPP describes the QA/QC methods, techniques, tools, protocols and other requirements necessary to ensure the collection of precise, accurate, and complete environmental data.

5.1.1 FIELD QA/QC

All sampling is conducted according to SOPs to ensure collection methods are reproducible and data is representative of the media. QC checks employed by WAPB staff in the field include equipment calibrations with reference standards, collection of field duplicates and matrix

spike/matrix spike duplicate samples, duplicate samples, and field blanks. Standard operating procedures (SOPs) are stored electronically on IDEM's computer network and are available to all staff.

As part of its External Data Framework, the WAPB is working with Purdue University to make many of OWQ's monitoring protocols available online for use by external organizations interested in submitting data to OWQ for potential use in its decision-making processes. It is anticipated that the Catalog of Monitoring Protocols will support greater data sharing through the External Data Framework by providing external organizations the information they need to enhance the comparability of their data to the data collected by the WAPB.

5.1.2 LABORATORY QA/QC

OWQ's surface water QAPP also identifies the QC checks that must be used in IDEM's contracted laboratories that analyze samples collected by the WAPB. Such QC checks could include instrument calibration and/or verification, laboratory duplicates and matrix spike/matrix spike duplicate samples, method blanks, the use of external standards, laboratory control samples, and surrogates, serial dilution, and interference checks.

5.1.3 DATA QUALITY REVIEW

The QAPP serves as a guide for QA/QC review by OWQ's contract laboratories and the WAPB staff charged with reviewing the analytical results they provide to ensure they meet the data quality requirements of the monitoring objective(s) for which the samples were collected.

WAPB staff reviews all laboratory data reports to determine laboratory compliance with U.S. EPA approved methods and that the QA/QC procedures as prescribed in the QAPP have been followed for individual parameters. As part of the review process, a data quality assessment (DQA) level is assigned to each report to indicate the usability of the results. These DQA levels also provide the foundation for the data quality acceptance criteria currently being developed for water quality data submitted through OWQ's External Data Framework:

Level 1 Screening Data – Results are usually generated onsite and have no QC checks. Analytical results that contain numbers with no corresponding QC checks, precision or accuracy information, or detection limit calculations are included in this category. Level 1 data are usable for pre-surveys and for preliminary rapid assessment.

Level 2 Field Analysis Data – Data are recorded in the field or laboratory on calibrated or standardized equipment. Field duplicates are measured on a regular periodic basis. Calculations may be done in the field or later at the office. Analytical results, which have limited QC checks, are included in this category. Detection limits and ranges have been set for

each analysis. Information regarding QC checks for field or laboratory results is useable for estimating precision, accuracy, and completeness of the data set. Level 2 data are used independently for rapid assessment and preliminary decisions.

Level 3 Laboratory Analytical Data – Analytical results include QC check samples for each batch of samples from which precision, accuracy, and completeness can be determined. Method detection limits (MDLs) have been determined using 40 CFR Part 136 Appendix B. For contract laboratories, all reporting information required in the laboratory contract, and in the surface water QAPP is included in the analytical data reports. Raw data, chromatograms, spectrograms, and bench sheets are not included as part of the analytical report, but are maintained by the contract laboratory for easy retrieval and review. Data can be elevated from DQA Level 3 to DQA Level 4 if this information is included in the data report and the QC data are reported using U.S. EPA Contract Laboratory Program forms or format. Level 3 data are considered complete and legally defensible for regulatory decision-making.

Level 4 Enforcement Data – Analytical results, for the most part, meet U.S. EPA Contract Laboratory Program requirements for data analysis, contract required quantification limits and validation procedures. QC data are reported using Contract Laboratory program forms and/or format. . Raw data, chromatograms, spectrograms, and bench sheets are included as part of the analytical report. All reporting information required in the laboratory contract and OWQ's surface water QAPP is included in the analytical data reports. Level 4 data are considered complete and legally quantitative in value for the purposes of regulatory decision-making and enforcement.

5.1.4 TIMELINES FOR QAPP REVIEW AND SOP DEVELOPMENT/REVISION

OWQ's surface water QAPP was first approved internally by IDEM in 1999, and updated and approved by U.S. EPA in 2004 and is updated and revised as significant changes are made to OWQ's surface water monitoring programs. Based on the changes outlined in this revised *Strategy*, the WAPB plans to review and revise its QAPP accordingly. Based on OWQ's timeline associated with implementing these changes and that the WAPB may yet identify additional changes through programmatic evaluation, review of the QAPP will not begin until 2012. IDEM will report on its progress in revising the QAPP in its 2014 revision of the *Strategy*.

SOPs are reviewed periodically and revised when necessary to reflect changes in monitoring and/or analytical procedures. OWQ plans to develop and or revise existing SOPs as needed to incorporate the changes described in this *Strategy* and is considering the development of a new SOP to guide the coordination processes critical to its successful implementation.

5.2 QUALITY ASSURANCE OF CLEAN LAKES PROGRAM MONITORING

CLP monitoring is guided by two separate QAPPs, one for sampling and analyses conducted by IU/SPEA and another for the volunteer monitoring supported through the CLP. The CLP is currently funded through OWQ's Nonpoint Source Program, which requires that both QAPPs be reviewed and revised prior to the initiation of sampling activities under each new grant cycle. Both QAPPs are available to IU/SPEA students, staff, and CLP volunteers to guide their monitoring. IU/SPEA has also developed two [volunteer monitoring manuals](#), one for the regular CLP monitoring and another for the Expanded Program, to serve as SOPs for CLP volunteers.

5.3 QUALITY ASSURANCE OF OWQ'S GROUND WATER MONITORING NETWORK

The ground water monitoring activities discussed in this *Strategy* are covered in sub-QMP for the Drinking Water Branch (IDEM, 2009). The specific procedures for implementing them are described in the Statewide Ground Water Monitoring Network SOP (IDEM, 2010). All data collected through the GWMN are analyzed by contract laboratories. The project manager is responsible for ensuring that monitoring procedures are correctly implemented and that the SOP is followed. Data quality review is conducted by the project chemist who determines if the data conforms to the QA/QC standards.

6 DATA MANAGEMENT

OWQ relies primarily on three databases to manage the data collected by its surface water monitoring programs – the U.S. EPA Assessment Database (ADB), the IDEM Assessment Information Management System (AIMSII), and the U.S. EPA Storage and Retrieval (STORET) databases. These databases are necessary to accurately organize water quality data, store it securely, and to make the data easily available to IDEM staff and other customers for use in various applications. They also enhance data quality by simplifying electronic data submission to reduce human error and by simplifying various quality assurance (QA) and quality control (QC) processes. Results from OWQ's ground water monitoring programs and Clean Lakes Program (CLP) monitoring are stored in separate databases administered by their respective programs.

6.1 OWQ'S ASSESSMENT INFORMATION MANAGEMENT SYSTEM DATABASE (AIMS II)

The AIMS serves as a central repository for nearly all of the data collected by the WAPB's surface water quality monitoring programs. Water quality information stored in the AIMSII database is used for tracking water quality assessment data and designated use attainment, cataloguing impairments, and tracking causes and sources of impairment.

IDEM has recently completed a project to upgrade the AIMS database based on its original code. Among new features to the system, now called AIMSII, is a web-based front-end application that allows access to the data tables in which water monitoring results and other information are stored. This has been deployed over the IDEM extranet for better accessibility throughout the agency.

The resulting AIMSII database facilitates project planning and data quality assurance, analysis and reporting. AIMSII is a centralized data storage and retrieval system that provides an efficient and easily accessible database of surface water resource information to serve the needs of IDEM and other stakeholders. AIMSII stores results for physical and chemical surface water parameters, fish community data (both the index of biological integrity scores and individual metrics), macroinvertebrate community data (both the macroinvertebrate index of biological integrity scores and individual metrics), bacteriological data, habitat information, fish tissue contaminant data, and sediment contaminant data. These data can be retrieved in a variety of ways including by location (latitude/longitude, decimal degrees or Universal Transverse Mercator) sample collection date, waterbody name, hydrologic unity code, county, ecoregion, etc. The web front-end application for AIMSII was developed to assist staff in all phases of project implementation from the planning stage through data analysis and reporting. The application utilizes a Microsoft .Net web application to access data that are stored in Oracle tables.

In addition to efficient data storage and retrieval, AIMSII provides a structure to assist in conducting QA analysis of data that is entered into the database. A number of specific steps have been incorporated into OWQ's information management process and where possible, have been built into the AIMSII application. This includes procedures and formats for the following:

- Data entry and QC standards for overall data quality assessment.
- Data quality assessment to define precision and accuracy of results.
- Data and information dissemination and related documentation.
- Data reduction (scores and other metrics as environmental indicators).
- Standards for use of data in reports (using known data quality assessment for each project).

6.1.1 MANAGEMENT OF NONPOINT SOURCE GRANT PROJECT DATA AND DATA SUBMITTED THROUGH OWQ'S EXTERNAL DATA FRAMEWORK

The AIMSII database also includes the ability to integrate nonpoint source monitoring data collected by external organizations for projects funded through IDEM's Nonpoint Source Program and others interested in submitting their data through the External Data Framework when implemented.

While many of the external sources of information may be from volunteer or other monitoring professionals, the ability to integrate data from multiple sources will allow OWQ to better support internal and external data requests by providing a more comprehensive set of data, which is accurately characterized in terms of its data quality and appropriateness for various uses.

In addition to storing water quality data collected by nonpoint source project and other external partners, AIMSII also supports watershed planning and implementation efforts with its ability to store modeled results for load reduction estimates based on specific types of best management practices. The ability to store this type of information provides a one-stop location for retrieving both nonpoint source data and data collected by the WAPB for the purposes of analyzing modeled load reductions and water quality data together.

The new nonpoint source function of AIMSII supports the internal data management needs associated with OWQ's External Data Framework and serves as an important component of the guidance that external organizations can receive. The templates developed for nonpoint source data submission can be used by any external organization to standardize its project "metadata" and its water quality data for submission through the External Data Framework. Providing such documentation helps external organizations ensure that the data they collect are of known quality, enhancing the usability of the data and creating new opportunities for collaboration.

6.2 U.S. EPA'S STORAGE AND RETRIEVAL DATABASE (STORET)

Data generated and collected by the WAPB will be entered into U.S. EPA's Storage and Retrieval (STORET) database, which serves as a central repository for water quality data submitted by contributing agencies and organizations. STORET is a national water quality database that provides analysts opportunities to examine spatial and temporal changes in water chemistry for a wide range of parameters throughout the nation's watersheds. STORET facilitates IDEM's compliance with reporting requirements of PL 92-500 CWA and IDEM's Environmental Performance Partnership Agreement with U.S. EPA.

The recently upgraded AIMSII database now has the capability to generate data sets that can be submitted to the IDEM Water Quality Exchange (WQX) Node for direct transmission to STORET.

It is anticipated that uploading the existing data in AIMSII will begin early in 2011 and be completed by June 30, 2011. After the initial upload, frequent and regular uploads will be conducted to maintain IDEM data currency in STORET.

6.3 OWQ'S ASSESSMENT DATABASE (ADB)

The ADB is a specialized database developed by U.S. EPA for states to store information related to their CWA Section 305(b) and 303(d) assessment and listing decisions and their CWA Section 314 assessments. The ADB may be considered a “companion” database to AIMSII. AIMSII stores water quality monitoring data while the ADB stores assessment decisions based on those data. OWQ uses the ADB to organize this information for the purposes of developing its Integrated Water Monitoring and Assessment Report and 303(d) List of Impaired Waters and provides a copy of the ADB to U.S. EPA every two years. U.S. EPA uses this information to incorporate Indiana's water quality assessment information into its national water quality assessment database and to prepare its CWA 305(b) report to Congress.

A critical component in OWQ's management of CWA assessment information is its Reach Index. OWQ developed its Reach Index based on the USGS National Hydrography Dataset (NHD)¹. Through the reach indexing process, OWQ assigns every waterbody that appears on the NHD for Indiana a unique assessment unit identification code (AUID), which defines the extent of the waterbody that is considered representative for the purposes of water quality assessments. The AUIDs in Indiana's Reach index allow OWQ to “key” the waterbody assessment information stored in the ADB to their geographical location. This facilitates mapping Indiana's 305(b) assessments and 303(d) listings in GIS applications and incorporation of this information into U.S. EPA's national databases.

OWQ developed its first Reach Index in 2002 based on the USGS medium resolution NHD (1:100,000 scale) NHD. The NHD is now available at high resolution (1:24,000 scale) for Indiana and contains a significantly higher number of first and second order streams than are shown on OWQ's original Reach Index. These small streams and stream networks are an important component of the hydrology in their watersheds and can have significant effects on water quality in larger streams. Given this, IDEM began an extensive effort in 2008 to revise the Reach Index to incorporate the additional waters that appear at the 1:24,000-scale NHD. This work is ongoing and is completed by existing staff as time allows. When this work is complete, it will

¹ The NHD is a database created by U.S. EPA and the U.S. Geological Survey that provides a comprehensive coverage of hydrographic data for the United States. It uniquely identifies and interconnects the stream segments that comprise the nation's surface water drainage system and contains information for other common surface waterbodies such as lakes, reservoirs, estuaries, and coastlines.

provide a statewide Reach Index that will facilitate more comprehensive and representative water quality assessments.

6.4 CLEAN LAKES PROGRAM DATA MANAGEMENT

Currently CLP data are stored in a database managed by Indiana University School of Environmental Affairs (IU/SPEA), which administers the program for IDEM under a CWA Section 319 grant. These data are provided to IDEM regularly for the purposes of making its CWA assessments, which are then entered into OWQ's ADB.

6.5 OWQ'S GROUND WATER MONITORING NETWORK DATABASE

Results from ground water sampling conducted through OWQ's Ground Water Monitoring Network and Citizen's Complaint Monitoring Program are currently entered into the Ground Water Monitoring Network Database. This is a Microsoft Access database developed by OWQ and maintained by staff in OWQ's Ground Water Section. OWQ plans to make this database available online to facilitate downloading of the data when resources become available. In order to ensure the security of public and private drinking water supplies, results are associated with estimated locations only.

7 DATA ANALYSIS AND ASSESSMENT

All water monitoring data collected will be interpreted to meet the monitoring objectives identified in Table 1 of this *Strategy*

7.1 CWA SECTION 305(B) DESIGNATED USE ASSESSMENTS AND DEVELOPMENT OF INDIANA'S CWA SECTION 303(D) LIST OF IMPAIRED WATERS

OWQ's CWA 305(b) designated use assessments and the development of its 303(d) List of Impaired Waters are guided by the Agency's Consolidated Assessment and Listing Methodology (Appendix 2). Almost all of the water quality data collected by the WAPB can be used to support CWA 305(b) assessments. The data are compared to the narrative and numeric water quality criteria articulated in Indiana's water quality standards to determine the extent to which the waterbody supports its designated beneficial uses. Waters that fail to meet the designated use assessed are placed on the 303(d) List of Impaired waters.

7.2 CWA SECTION 314 ASSESSMENTS OF LAKE TRENDS AND TROPHIC STATE

OWQ uses the Indiana Trophic State Index (ISTI) to determine lake trends and trophic state for the purposes of CWA Section 314. The ITSI consists of 10 metrics which are identified in Table 12 as core indicators which must be evaluated together in order to achieve an accurate score. The metrics include biological, chemical, and physical parameters. Water samples for nitrogen

and phosphorus are collected and analyzed from both the epilimnion and the hypolimnion and the mean of the values is assigned a certain number of eutrophy points based on the mean concentration. OWQ's methods for calculating the ISTI score and using this score to assign a trophic status are described in its Consolidated Assessment and Listing Methodology (CALM), which is provided in Appendix 2.

7.3 TMDL DEVELOPMENT

Data collected for TMDL development are used in conjunction with continuous flow data, which is typically obtained from the nearest United States Geological Survey (USGS) gaging station, to develop load duration curves.

The flow data is used to create flow duration curves, which display the cumulative frequency of distribution of the daily flow for the period of record. The flow duration curve relates flow values measured at the monitoring station to the percent of time that those values are met or exceeded. Flow duration curves are transformed into load duration curves by multiplying the flow values along the curve by applicable water quality criteria values for the pollutant in question and appropriate conversion factors.

Pollutant loads are estimated from the water quality monitoring data as the product of the pollutant concentrations, instantaneous flows measured at the time of sample collection, and appropriate conversion factors. In order to identify the plotting position of each calculated load, the recurrence interval of each instantaneous flow measurement was defined. Water quality pollutant monitoring data are plotted on the same graph as the load duration curve that provides a graphical display of the water quality conditions in the waterbody. The pollutant monitoring data points that are above the target line exceed the water quality criteria, and those that fall below the target line meet the applicable water quality criteria.

7.4 MEASUREMENT OF CLEAN WATER ACT GRANT PROGRAM PERFORMANCE

Based on U.S. EPA's Strategic Plan, most of the performance measures which OWQ's CWA grant programs must meet require measureable improvements in water quality as demonstrated by the removal of one or more impairments from the state's 303(d) list. Therefore, the data collected for the purposes of measuring OWQ's grant program performance are analyzed in the same manner as data collected for the purposes of making CWA 305(b) designated use assessments and developing the 303(d) list, which is described in OWQ's CALM (Appendix 2). Waters that are identified through these monitoring activities to be now meeting the applicable water quality criteria for the parameter(s) originally impaired may be removed from the 303(d) list and considered a measure of success subject to the criteria outlined in U.S. EPA's Strategic Plan and summarized in Section 2.1.7 of this *Strategy*.

7.5 DETERMINATION OF WATER QUALITY TRENDS

7.5.1 TRENDS IN FISH TISSUE CONTAMINANTS

The WAPB maintains an extensive fish contaminants database that allows for trend assessment at many different levels of resolution, local to statewide. In order to maintain the levels of resolution, adequate data collection on an annual basis is necessary. Fish tissue concentrations are compared to numerous established state and national benchmarks. Increases and decreases of these benchmark exceedances across time is an indicator of trends. Numerous species are utilized as indicators in building weight-of-evidence trends in contaminants. Numerous graphic and tabular methods of displaying and interpreting data are used in order to analyze trends temporally and spatially. Reports are generated based on these analyses.

7.5.2 TRENDS IN WATER CHEMISTRY COLLECTED AT FIXED STATIONS

Data for trend analysis reports are screened against water quality standards for the most common parameters such as metals and nutrients. Nutrient values that have no standards are compared to median values from all fixed station data. Sites that have data in noncompliance with standards or above median values are identified for trend analysis. Trends are analyzed temporally and spatially. Temporal trend analysis is completed using a Seasonal Kendall test, looking at the data over a long period of time while accounting for seasonality differences. Spatial trend analysis is completed by comparing a succession of sites along the same waterbody, using histograms and box and whisker plots for evaluation. Load duration curves are also created to look at pollutant loadings along a waterbody.

7.5.3 DEVELOPMENT OF OTHER TYPES OF TREND INFORMATION

The WAPB recognizes the need for the development of new types of trend analyses of water quality data. Defining the types of trend analyses that the WAPB may be able to conduct with existing data will help to inform future decisions regarding water quality monitoring activities and other resource management decisions.

7.6 DEVELOPMENT OF PUBLIC HEALTH ADVISORIES

7.6.1 RECREATIONAL USE ADVISORIES

Toxic Cyanobacteria Alerts – The cyanobacteria and microcystin data collected through IDEM are used by the Indiana State Department of Health (ISDH) to educate swimmers and boaters of possible high levels of blue-green algae at a selection of Indiana’s reservoirs and lakes. Precautionary measures are advised during the recreational season if cyanobacterial cell counts

are greater than 100,000 cells per milliliter (cells/mL) or if microcystin toxin concentrations are greater than 6.0 parts per billion (State of Washington 2008). These levels are utilized by the ISDH as the level for posting advisories for the state. The 100,000 cells/mL benchmark is also the level of moderate risk for adverse health effects as determined by the World Health Organization.

Beach Closures – The funds IDEM provides Lake Michigan coastal communities from the Beaches Environmental Assessment and Coastal Health (BEACH) Act are used to monitor public beaches and post public health advisories. Water samples are analyzed for *E. coli*, a core indicator of disease-causing organisms, using either a 16-18 hour test or a 24-hour test. If a water sample concentration exceeds the 235 colony forming units per 100 mL (the state and federal criterion for *E. coli*), the beach manager must take action by either posting an advisory or closing the beach. These data may also be used by organizations outside of IDEM to develop predictive models.

7.6.2 FISH CONSUMPTION ADVISORIES

The fish tissue contaminants data collected through IDEM are used by the ISDH to advise the public on safe fish consumption of recreationally caught and commercial fish. This is an annual collaborative effort of IDEM, ISDH, and the Indiana Department of Natural Resources with support from Purdue University. Fish tissue data are analyzed to determine the amounts of fish that are safe to consume, which depends on the species, size, and location of where the fish are caught. Indiana's sport fish advisories are currently based on levels of polychlorinated biphenyls (PCBs) and mercury found in fish tissue. During the last four decades more than 5,000 fish tissue samples have been analyzed for PCBs, pesticides, and heavy metals of concern.

The decision-making criteria used to develop the FCA were developed from and are documented in the Great Lakes Sport Fish Advisory Task Force published in 1993.

7.7 WATERSHED MANAGEMENT PLANNING AND RESTORATION

OWQ has not yet determined all the analytical methods that will be used with the data collected through the new baseline monitoring activities described in this *Strategy*. These data will certainly be analyzed for the purpose of making CWA assessments. What remains to be determined is the level of assistance that watershed groups will need in interpreting monitoring results for their planning activities.

There are potentially many other approaches to analyzing the data that OWQ will collect. These data will be collected to help watershed groups determine baseline conditions in their watersheds for the purpose of identifying sources of impairment and to plan and prioritize appropriate watershed restoration activities.

In order to know the level of assistance watershed groups will need in best utilizing these data, OWQ plans to develop a process for early and ongoing coordination with the groups for whom baseline monitoring is conducted to ensure that the study will meet their needs, to determine the types of data analysis they need and whether they have the capacity to do this work. OWQ will know more about the analytical methods that watershed groups plan to use with these data after 2011 when OWQ completes its first baseline study. The coordination process that OWQ develops to work with watershed groups on these projects and the analytical methods to be employed with the data collected will be described in the next scheduled revision of this *Strategy*.

7.8 GROUND WATER AND SOURCE WATER

Currently, data collected through OWQ's Ground Water Monitoring Network are analyzed by comparing results to maximum contaminant levels. Statistical analyses will require approximately five years' of data, more than are currently available. OWQ has almost three years of data to date and is currently exploring different methods for statistical analyses of the data. Methods for trend analyses under consideration include statewide intra-well comparisons, trends in ground water quality within and among different aquifers and across hydrogeologic settings. OWQ will use modeling to further analyze areas where ground water contamination is identified. In areas where sufficient surface water data exists, modeling may also be used to characterize surface water and ground water interactions.

8 REPORTING

8.1 INTEGRATED REPORTING

Section 305(b) of the CWA requires states to make water quality assessments and provide water quality reports to U.S. EPA, and Section 303(d) requires states to submit a list of impaired waters to U.S. EPA. Since 2002, in accordance with U.S. EPA guidance, the products from both of these processes, 305(b) water quality assessments and the 303(d) List of Impaired Waters, have been combined into one report for submission to U.S. EPA.

The Integrated Water Monitoring and Assessment Report (IR) contains the comprehensive results of many of IDEM's water quality assessments made for the purpose of section 305(b) and identifies water that are fully supporting and those that are not supporting their designated uses as defined in Indiana's water quality standards. Those that are not supporting are considered impaired and are placed on the 303(d) List of Impaired Waters. OWQ's processes for water quality assessment and listing process are described in detail in its Consolidated Assessment and Listing Methodology (CALM), which is provided in Appendix 2.

OWQ submits the entire IR, including the 303(d) list, to U.S. EPA every two years. Although U.S. EPA has no approval authority regarding the 305(b) component of the IR, OWQ also excerpts the 303(d) list and supporting materials from the IR and submits them separately to U.S. EPA to facilitate the federal review and approval process required specifically for the 303(d) component of the report.

The IR is also published on IDEM's website at: www.in.gov/idem/4679.htm. The components of the IR that comprise the 303(d) list are also published separately on IDEM's website at: www.in.gov/idem/4680.htm.

8.2 TOTAL MAXIMUM DAILY LOAD (TMDL) REPORTS

Total maximum daily load (TMDL) reports are developed to meet the requirements of CWA Section 303(d) and contain a quantitative assessment of water quality problems, contributing sources, and load reductions or control actions needed to restore and protect individual waterbodies.

The number of reports developed each year is determined by IDEM and U.S. EPA. The TMDL development schedule is included with IDEM's IR submission every two years and specifies the TMDLs that will be completed over the next two-year cycle. U.S. EPA imposes no specific order on the development of the TMDLs identified in the schedule, requiring only that they be submitted to U.S. EPA and approved by the end of the cycle.

TMDL reports can be used by watershed groups, state and local officials, municipalities, and others in their water quality restoration efforts whether they are implementing the measures provided in the TMDL or in their watershed improvement plans, or evaluating the status of water bodies where TMDLs or nonpoint source projects have been conducted. All TMDL reports completed or in progress are available online at: www.in.gov/idem/4685.htm.

8.3 U.S. EPA STRATEGIC PLAN PERFORMANCE MEASURE REPORTS

OWQ develops two types of reports to meet U.S. EPA's performance measures for its CWA programs:

- SP-12 (or Measure W) Reports
- Nonpoint Source Success Stories.

U.S. EPA conducts its own analysis of Indiana's 303(d) List of Impaired waters each cycle to determine the extent to which OWQ's programs are meeting the other performance measures described in this *Strategy*.

SP-12 (Measure W) Reports and Nonpoint Source Success Stories are very similar in format and the information they convey. Both highlight improvements in watersheds where waterbodies

previously identified as impaired are now meeting water quality standards. Nonpoint Source Success Stories focus specifically on improvements resulting from projects funded by IDEM's nonpoint source grant programs while the reasons for the improvements identified in the SP-12 reports may or may not be known.

In order to meet U.S. EPA's Strategic Plan Measures, OWQ must identify five watersheds that have been improved and develop the required SP-12 reports by 2012. U.S. EPA uses the Nonpoint Source Success Stories that OWQ develops for the purpose of tracking improvements in water quality that have results from federally funded watershed planning and restoration activities. IDEM is required to submit one Nonpoint Source Success Story to U.S. EPA annually.

8.4 REPORTING THROUGH PARTNERING AGENCIES

8.4.1 INDIANA STATE DEPARTMENT OF HEALTH FISH CONSUMPTION ADVISORIES

The Indiana Fish Consumption Advisory (FCA) is issued annually by the Indiana State Department of Health (ISDH) based on data provided from IDEM OWQ's fish tissue monitoring activities.

The development of the FCA is a collaborative, interagency effort. IDEM collects and manages the majority of the data. Indiana Department of Natural Resources (IDNR) has been instrumental in the collection of fish tissue samples from Lake Michigan and a number of inland lakes where special studies have been conducted. Each year, staff from the ISDH, IDEM, and the IDNR meet to discuss the findings of recent fish monitoring data and develop the new statewide FCA, which is published online at: www.in.gov/isdh/23650.htm.

8.4.2 REPORTING ON TOXIC CYANOBACTERIA AND BLUE-GREEN ALGAL COMMUNITIES

The cyanobacteria and microcystin data collected through IDEM monitoring will be used to develop a new environmental indicator that provides information necessary to protect human health and the environment. Although this monitoring is currently in the early stages of development it is anticipated that the results will help to determine environmental factors influencing the occurrence and concentration of blue-green algal toxins and if an empirical relationship can be developed between microcystin concentrations and environmental variables.

As primary producers, algae respond directly to nutrients, and can be very valuable for assessing nutrient impairments. Since algae can colonize a majority of stream substrata, algal assemblages can be monitored throughout the range of stream types found in Indiana. Moreover, algal taxa tend to have high dispersal rates, growth rates, and relatively short generation times, thereby allowing rapid response to changes in their environment.

Consequently, they can provide a temporal window for assessment that is complementary to (and shorter than, in many cases) that for fish and macroinvertebrates, and may be valuable for application in streams with short flow durations (*i.e.* intermittent streams and some ephemeral streams). IDEM conducts algal community monitoring with the intention of establishing algal metrics which will be used to support nutrient criteria development for Indiana's rivers and streams.

Microcystin results are reported through the ISDH. Algal community results are used internally to support nutrient criteria development and are made available to other state, federal and local agencies as requested.

8.5 BEACH ACT REPORTS

Funding from the federal Beaches Environmental Assessment and Coastal Health (BEACH) Act was used to develop the [BeachGuard Online Monitoring System](#), which allows any municipality or organization conducting bacterial monitoring at their beaches to post their results for the purposes of informing the public about potential health risks. The database is also available for non-coastal beach organizations that conduct bacterial monitoring on private beaches to report their results in collaboration with their local health departments. To date, the database contains six years of beach monitoring and notification information for more than 40 public beaches in Northwest Indiana including Lake Michigan beaches. All monitoring and notification data within BeachGuard is accessible to the public. This system allows the public to access up to date information on beaches for the purpose of making recreational use decisions.

Local beach managers use the results of their BEACH Act-funded monitoring activities to notify the public of potential risk by posting state-approved beach advisories or beach water closure signs at their beaches.

IDEM also provides Indiana's Lake Michigan shoreline beach communities with kiosks to display the beach advisory signs in addition to relevant information on the causes and risks associated with *E. coli* contamination.

8.6 LAKES MONITORING REPORTS

In addition to providing data to OWQ for its assessment and reporting processes, IU/SPEA develops Indiana Lake Water Quality Assessment Reports approximately every four years, which are published on the IU/SPEA CLP website at: www.indiana.edu/~clp/. Volunteer monitoring reports are also published on the IU/SPEA website, generally following the same timelines.

8.7 GROUND WATER REPORTS

The primary reporting mechanism for OWQ's ground water monitoring data is OWQ's IR. . In accordance with U.S. EPA guidance, OWQ provides a summary of its ground water monitoring data and a discussion of the results in the IR every two years. Major sources and of contamination are discussed along with OWQ's ground water protection efforts.

In addition to incorporating ground water monitoring results into the IR, results for sites sampled through the Citizen's Complaint Monitoring Program are provided to the homeowners requesting the sampling along with additional information to help them understand the results and better protect their wells.

Source water assessments under CWA 305(b) are conducted on surface waters only. These assessments are most often based on data collected at selected fixed stations and are reported with other designated use assessments in the IR.

8.8 BASELINE MONITORING REPORTS

The process for reporting on OWQ's new baseline monitoring activities described in this *Strategy* have not yet been determined. OWQ is working to ascertain the level of assistance that watershed groups will need in interpreting monitoring results. Internal mechanisms exist for reporting monitoring results to external parties, including watershed groups. However, if it is determined that watershed groups will need assistance from OWQ with data analysis, a formal means of communicating the resulting information will be required. It is anticipated that these questions will be resolved later in 2011 when OWQ conducts its first baseline study. Any new processes that are developed as a result will be included in the next scheduled revision of this *Strategy*.

8.9 TECHNICAL DATA SHEETS

Technical Data Sheets (Appendix 3) have been developed for Watershed Assessment and Planning Branch programs that support the *Strategy*. These provide program specific information specific to each of OWQ's monitoring activities including monitoring objectives, participants, description, specific products, technical notes, and contact information. Technical Data Sheets will be updated as time allows and will be developed for all the new monitoring activities described in this *Strategy* as time allows.

8.10 WATER QUALITY DATA REQUESTS

In addition to reporting data internally to IDEM programs that request it, OWQ routinely receives requests from external parties for water quality data stored in the Assessment Information Management System (AIMS II) database and assessment information stored in its

Assessment Database (ADB). Such requests are initiated primarily through email correspondence.

Approximately 100 water quality data requests are filled per year where data is provided in either spreadsheet or database file format. Other requests often require only an acknowledgement of the existence of data. Requests are normally filled within 3-4 days. As OWQ begins uploading its water quality data to U.S. EPA's Storage and Retrieval database on a regular basis, interested parties will be able to acquire data without waiting for IDEM staff to respond.

OWQ receives approximately 20-30 requests for assessment information each year, which are typically filled within two weeks of the initial request. For these requests, a report is generated from the ADB and is sent to the requester along with additional explanatory information as needed.

8.11 OTHER REPORTS

Data generated by the Special Studies Program may be reported in NPDES Permit or modeling documents, compliance or enforcement documents or included in data requests. All data are furnished to the requesting program area after the data set has been verified by the Watershed Assessment and Planning Branch's quality assurance process. Where appropriate, a report is prepared that summarizes and presents the data with comments and analysis.

9 PROGRAM EVALUATION

9.1 OWQ'S APPROACH TO EVALUATING ITS MONITORING PROGRAMS AND STRATEGY

When revising past monitoring strategies, the former Assessment Branch sent notice of the review, soliciting comments from branch staff and other water program area staff. The comments were examined, addressed, and then incorporated into the *Strategy* document where possible. The recent addition of staff from the Nonpoint Source Program, the Total Maximum Daily Load Program, and watershed planning staff to the monitoring branch of IDEM's OWQ, now called the Watershed Assessment and Planning Branch (WAPB), have enhanced communication between monitoring staff and staff in the CWA programs that rely on the data they collect. This reorganization was timely in that it coincided with the development of this revised *Strategy* and allowed for more effective collaboration.

Recognizing the need for an addition of a holistic, watershed approach to monitoring Indiana's water resources, the WAPB built on U.S. EPA's recommendations made regarding the previous *Strategy* to convene an interdisciplinary work group comprised of WAPB staff from multiple program areas. Over the course of several facilitated meetings, the Work Group:

- Discussed the different data types of data currently collected by the WAPB.
- Identified WAPB “customers” and their data needs.
- Identified and prioritized the monitoring objectives that would drive the *Strategy* going forward.
- Evaluated different options for obtaining the data necessary to meet the primary monitoring objectives and secondary objectives where possible.
- Made decisions regarding changes needed in the WAPB’s monitoring approaches to meet primary objectives identified
- Evaluated the resources needed to implement the revised *Strategy*.

After much consideration, the *Strategy* work group decided to alter the former five year rotating basin design to a nine year rotating basin design and to reduce the frequency of its monitoring at fixed stations in order to provide additional resources to meet the monitoring objectives that require targeted monitoring. The modification of its probabilistic design will still allow OWQ to make statistically valid assessments of all waters while addressing resource shortfalls that have hampered monitoring efforts in other areas. While the changes to the frequency at which fixed stations are monitored may reduce the statistical rigor of any trend analyses conducted with the data, the data collected will still be useful for meeting a number of primary monitoring objectives.

The WAPB understands that active management is essential to determine how to best utilize the resources made available by these changes in order to meet the monitoring objectives of this *Strategy*. Efforts have been made to reorganize extra resources into renewed targeted monitoring approaches, including:

- Reinvigorating some monitoring efforts that have been reduced as a result of reductions in staff and/or financial resources.
- More monitoring for Total Maximum Daily Load development.
- Assistance to nonprofit watershed groups in the form of baseline monitoring
- Monitoring to support watershed planning and to evaluate watershed restoration efforts.

9.2 TIMELINE FOR EVALUATIONS AND STRATEGY REVISIONS

In the past, the *Strategy* was evaluated and reviewed at least once every five years prior to the commencement of a new five year basin rotation schedule. Given the significant changes to the *Strategy* with this revision, more frequent review of the *Strategy* is necessary to allow for an adaptive management approach in order to ensure that these changes are producing the desired results (Table 14).

The WAPB will conduct a full review of the *Strategy* every three years going forward and will evaluate its monitoring programs annually. Both the full review and the annual evaluations will be conducted using a collaborative interdisciplinary approach similar to that which was employed for the development of the current *Strategy*. Such evaluations will occur in the later part of the year after the monitoring season has ended. The evaluation process will be particularly important for 2011 as it will be the first year in which a number of new targeted monitoring activities are to be implemented. The information gained in this first year of implementation will help OWQ determine if any additional changes might be needed to its targeted monitoring approaches. Planning for the following years targeted monitoring may be conducted separately or incorporated into the meetings held for the purposes of program evaluation.

Table 14: Timeline for WAPB program evaluation and monitoring strategy review.

Year	Review Type
2011	Annual monitoring review, implementation review
2012	Annual monitoring review
2013	Annual monitoring review, <i>Strategy</i> review
2014	Annual monitoring review
2015	Annual monitoring review
2016	Annual monitoring review, <i>Strategy</i> review
2017	Annual monitoring review
2018	Annual monitoring review
2019	Annual monitoring review, <i>Strategy</i> review

9.3 FUTURE ENDEAVORS

As monitoring needs and resources change, the WAPB will be flexible and adapt. For example, the WAPB has implemented new monitoring activities to support nutrient criteria development and to respond to recent public concerns regarding cyanotoxins in Indiana lakes and reservoirs. The WAPB has also begun to identify soft algae and diatoms in stream samples with the goal of developing an algal index that can be used to indicate the overall health of the aquatic ecosystem. Although both programs are currently funded with supplemental CWA

Supplemental 106 monies, the WAPB is making efforts to integrate these initiatives into its annual monitoring activities after these grants end.

9.3.1 FUTURE CHANGES TO OWQ'S MONITORING STRATEGY FOR LAKES

It is anticipated that the development of nutrient criteria for lakes will require potentially significant changes in OWQ's approach to monitoring and assessment of lakes for the purposes of CWA Section 305(b). It is a certainty that OWQ will have to revise its current water quality assessment process for lakes in order to implement new criteria. Because the water quality assessment process is dependent on water quality data, OWQ's approach to monitoring will also have to change accordingly once nutrient criteria are codified in Indiana's water quality standards.

In addition to the technical issues associated with the implementation of nutrient criteria for lakes, there are also policy considerations and funding issues that OWQ must take into account when making any changes required to its approach to monitoring lakes. Once the nature and scope of these changes are better known, OWQ will likely have to evaluate its options for funding the monitoring necessary to continue making its CWA assessments for lakes. Also, state procurement laws do not allow OWQ to dictate its needs to grantees, only to contractors. Therefore, OWQ will have to transition its lakes monitoring program from a nonpoint source grant project to an external partner, which is how current monitoring program is funded, to do one of the following options:

- Option 1 – Secure monitoring services from an outside contractor through a Request for Proposals.
- Option 2 – Conduct lakes monitoring in-house with OWQ staff resources.

Both options present significant challenges. With Option 1, OWQ the chief difficulty will be to identify an adequate and appropriate funding source. Option 2 is not possible with current staffing levels, and getting new positions to fully implement the *Strategy*, even without the additional burden of lakes monitoring, has proven difficult to date. In addition, a funding source would likely need to be identified to cover the analytical costs for these samples as OWQ does not presently have the staff or laboratory facilities necessary for this work.

The degree to which the CLP will be able to continue meeting our needs with regard to collecting water quality data to support OWQ's decision-making processes is still unknown, and it is still too early to make any major decisions regarding the nature and scope of the CLP's role in meeting our future monitoring needs. The *Strategy* Work Group determined that continued funding of the CLP through IU/SPEA through 2013 would provide IDEM with important benefits:

- An active volunteer monitoring program that promote awareness, stewardship and provides good screening data.
- Technical expertise provided by IU/SPEA through the CLP that IDEM can rely on to address lakes-related questions from the public.
- Funding the monitoring component of the CLP through 2013 will provide sufficient data for CWA assessments until the necessary changes to OWQ's monitoring strategy for lakes can be made.

Table 15 illustrates the timeline for key events and activities that will influence OWQ decisions regarding its approach to monitoring lakes from 2012-2014. OWQ anticipated that it will know more about how to proceed with its lakes monitoring program by 2013 when OWQ conducts its next review and revision of this *Strategy*.

Table 15: Key events and activities that will influence OWQ decisions regarding its approach to monitoring lakes (timelines shown pertain only to nutrient criteria for lakes).

Event/Activity	2011				2012				2013				2014			
	QTR 1	QTR 2	QTR 3	QTR 4	QTR 1	QTR 2	QTR 3	QTR 4	QTR 1	QTR 2	QTR 3	QTR 4	QTR 1	QTR 2	QTR 3	QTR 4
Nutrient criteria stakeholder meetings																
Preliminary adoption of nutrient criteria																
Final U.S. EPA approval of nutrient criteria																
Development of methodology to implement nutrient criteria for																
Revision to current monitoring approach to support implementation of nutrient criteria																
Development of SOP and QA protocols for revised approach to lakes monitoring																
Currently Planned Monitoring Activities Conducted by the Clean Lakes Program with Funding from IDEM OWQ																
CLP sampling under current 319 project																
CLP sampling under 319 project proposed in FFY 2011															1	
Microcystin sampling under CWA Supplemental 106 grant																
Options for Implementation of Revised Monitoring Approach for Lakes																
Option 1: Monitoring services secured through RFP																
Development of RFP for lakes monitoring to support implementation of nutrient criteria																
Contractor begins sampling																
Option 2: Monitoring conducted in-house by OWQ staff																
OWQ staff to develop work plans																
OWQ staff begins sampling																

¹The CWA Supplemental 106 grant that funds the CLP microcystin monitoring requires that samples be collected at the same time samples are collected for the purposes of CWA assessments. Because the monitoring associated with the CLP project proposed for FFY 2011 will likely be funded only through 2013, OWQ may have to shorten the term of the microcystin project accordingly.

10 GENERAL SUPPORT AND INFRASTRUCTURE PLANNING

During the development of this *Strategy*, the WAPB has identified several efficiencies that will enable the branch to better meet more of its primary water monitoring objectives despite consistent reductions of staff and budget to date.

These efficiencies will be achieved through changes in OWQ's approach to probabilistic monitoring and fixed station monitoring. OWQ has decided that in order to make best use of limited resources, beginning with the 2011 sampling season, probabilistic monitoring will be conducted in one basin per year instead of two, which essentially reduces the number of sites to be sampled by 50 percent. This allows staff previously assigned to do this work to be reallocated to other sampling efforts. Another significant change is the reduction in the frequency at which most fixed stations are monitored, which allows for additional flexibility with current staff and the reallocation of analytical support to targeted monitoring needed to meet primary water monitoring objectives.

A comprehensive budget for all of OWQ's monitoring activities is included in Appendix 1 and summarized here. The total annual costs for OWQ's surface water monitoring activities described in this *Strategy* total approximately \$3 million and include laboratory analytical costs, staff salaries, travel, equipment and supplies. This amount does not include the services provided by partnering agencies such as ISDH and IDNR (Appendix 1, Table 1). For OWQ's ground water monitoring activities cost an additional \$1 million annually (Appendix 1, Table 3). Surface water quality monitoring conducted by external organizations with funding from IDEM is estimated to cost \$343,000 to \$403,000 each year (Appendix 1, Table 2).

All available funding for the costs associated with the monitoring activities conducted by OWQ has been allocated to one or more programs (Appendix 1, Table 4) to produce a comprehensive budget for planning purposes (Appendix 1, Table 5). Based on this budget, OWQ is currently facing a shortfall of approximately \$558,000 in funds necessary to do all the laboratory analytical work associated with full implementation of the monitoring programs as described in this *Strategy*. Therefore, it is anticipated that some of these monitoring activities will have to be scaled back accordingly, either in terms of the number of sites monitored or the frequency at which they are sampled.

10.1 CURRENT STAFF RESOURCES

The current economic climate has prevented OWQ from filling vacated positions in its monitoring programs for the last several years. In 2010, OWQ reorganized its programs, combining nonpoint source watershed management activities, TMDL development, integrated reporting and water quality monitoring functions together into one branch. The creation of a single branch combining the efforts of nonpoint source pollution prevention, watershed management, and water monitoring has facilitated greater cross-program communication and has consolidated staff resources for more efficient work.

The newly formed WAPB contains 42 full-time employees with a broad range of expertise, including biological and chemical water quality monitoring, watershed planning and TMDL

development, GIS coordination and QA/QC review, etc. This has created opportunities for cross-training and synchronization between programs.

The changes described in this *Strategy* from a five-year rotating basin probabilistic strategy to a nine-year probabilistic strategy and the change of monthly fixed station monitoring to quarterly monitoring will result in significant efficiencies in staffing. Figure 4 illustrates these efficiencies in terms of the number of days available for monitoring activities before and after these changes. However, it is important to note that the number of days available as a result of OWQ's changes in its probabilistic and fixed station monitoring approaches does not represent a cost-savings in terms of staff resources. Rather, the resources now available are the result of careful consideration of the tradeoffs that make possible their reallocation to other primary monitoring objectives that OWQ has, to date, struggled to meet. Specifically, these staff resources are being reallocated to assist new targeted monitoring efforts including watershed baseline monitoring and monitoring necessary to meet U.S. EPA performance measures.

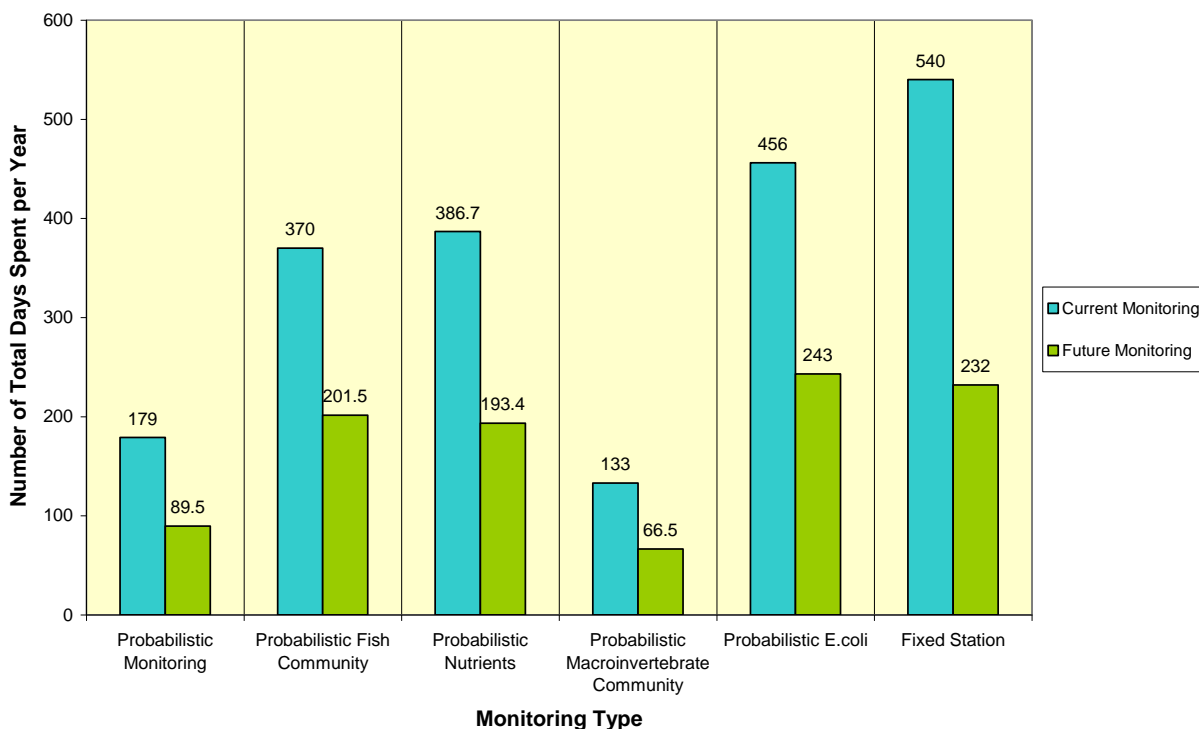


Figure 4: Comparing current to future monitoring time commitments.

The efficiencies illustrated in Figure 4 can also be deceiving due to other staffing issues which are significant but difficult to convey in a chart. For example, Figure 4 represents only current staffing levels and does not illustrate the number of monitoring staff lost in recent years through attrition and whose positions remain vacant. As a result, OWQ has struggled to meet the primary monitoring identified in Table 1 even before the changes proposed in this *Strategy*

and has been forced to rely on non-monitoring staff from other areas to assist in sampling. This practice has potentially significant costs that are difficult to quantify. For staff whose primary jobs do not involve monitoring, a day spent in the field means that other work must be put off or left undone, and the fact that there are a number of positions that remain vacant in the branch's non-monitoring program areas further exacerbates this problem.

Prior to the 2010 monitoring season and for many years, the WAPB was fortunate in its ability to secure several paid interns for the entire sampling season each year. These interns represented a significant resource available to conduct monitoring activities. However, the program that funded them has since been suspended indefinitely as a result of recent state budget cuts. While OWQ has made arrangements to secure a small number of unpaid interns, they are seldom able to work an entire sampling season due to their financial needs.

While the changes proposed to OWQ's approach to probabilistic and fixed station monitoring will allow reallocation of current staff to meet more of OWQ's primary monitoring objectives, it is anticipated that staffing will remain a critical limiting factor in OWQ's ability to fully implement this *Strategy*.

10.2 CURRENT LABORATORY SUPPORT AND OWQ LABORATORY RESOURCES

Laboratory support for the surface water and ground water chemistry samples and fish tissue samples OWQ collects comes from a combination of contract laboratories, in-house lab support, and state agency lab support.

Surface water chemistry samples and fish tissue samples are collected and delivered to certified laboratories under contract with the State of Indiana according to the WAPB quality control measures. The new probabilistic design will make available approximately half of past laboratory resources associated with water chemistry sampling. These resources will be reallocated to the extent possible to the fish tissue and sediment contaminants monitoring to bring it back to its funding levels. The funding level shown for this monitoring in Appendix 1 indicate annual funding prior to 2009 and represents what OWQ considers the minimum level necessary to meet the monitoring objectives for which these data are collected. It is anticipated that a portion of these funds will also be reallocated to support watershed baseline monitoring.

Analytical support for fixed station monitoring is provided at no cost to IDEM through a memorandum of agreement with the ISDH. This relationship is reciprocal in nature as OWQ contributes a significant amount of fish tissue data to the development of the ISDH FCA each year, the analytical costs of which are covered by OWQ's Contract Laboratory Services Fund. In addition, the WAPB also conducts monthly sampling at selected sites for radiological parameters for the ISDH Radiochemistry Laboratory in support of the Indiana Department of Homeland Security Radiological Emergency Preparedness Program.

The new quarterly fixed station monitoring design will make available a large amount of analytical capacity through ISDH. However, this capacity will be fully utilized with the samples collected through the new watershed baseline sampling activities that will occur monthly at selected sites each year. Therefore, it is anticipated that the changes in OWQ's monitoring approaches will result in no net change in the number of samples and types of analyses performed for IDEM by the ISDH laboratory.

It should be noted that despite OWQ's changes in its fixed station monitoring, the number and scope of watershed studies that OWQ may conduct is limited by the laboratory support available. It is estimated that the change in fixed station monitoring frequency will make available ISDH capacity for approximately 100 samples per month. Based on the geometric design the described in Section 3, the minimum scale watershed baseline study will produce approximately the same number of samples. For eight months of the year, OWQ can send these samples to ISDH for analysis. However, during the other four months when ISDH's analytical capacity is reached with OWQ's fixed station samples alone, watershed baseline samples will likely need to be sent to a contract laboratory, which represents an additional cost that must be met through an alternative to ISDH. Based on current levels of laboratory support available through ISDH and funding for contract laboratory support, OWQ does not have sufficient laboratory resources to conduct any more than the minimum watershed baseline study.

OWQ has not identified a potential funding source for the additional data that may be needed to better support the NPDES Program's needs for determining background conditions for permit development. Once these needs are better defined, WAPB staff currently monitoring at fixed stations may be able to conduct the sampling needed. However, additional resources will be needed to accommodate these additional analytical costs.

The WAPB currently operates three laboratories. One laboratory is used primarily for the calibration and maintenance of water quality monitoring equipment, while the other two are used for sample processing and analysis.

The WAPB's bacteriology laboratory is used analyze almost all of the *E. coli* samples collected through the WAPB's various monitoring activities and is augmented by two mobile *E. coli* laboratories, in which sample analyses can be conducted while in the field.

The WAPB's biological laboratory consists of two separate, smaller laboratories, one in which fish samples are processed and identified and another where macroinvertebrate samples are processed and identified.

10.3 CURRENT FUNDING SOURCES

OWQ relies on a variety of funding sources and services provided by partnering agencies to support its monitoring activities, including:

- CWA 106 Grant Funds
- CWA 319 Grant Funds
- Laboratory Services Contract Fund
- CWA Supplemental 106 Grant Funds
- CWA Section 205(j) Grant Funds

10.3.1 CWA SECTION 106 FUNDS

Federal CWA Section 106 funds are granted to IDEM by U.S. EPA, and are based on IDEM's Environmental Performance Partnership Agreement with U.S. EPA, which is renewed every two years. Indiana's CWA Section 106 varies from year to year based on the federal congressional budget and is augmented by monies from the state's General Funds, which are added as match for the federal funds received.

CWA Section 106 funds provide the primary support for many OWQ programs including those that conduct water quality monitoring as well as other programs that do not. OWQ allocates the largest portion of the CWA 106 funds received to support surface water programs (Surface Water 106), with the remaining funds allocated to ground water programs. These funds are treated as two different funding sources in Appendix 1 for the purposes of budgeting and are referred as Surface Water 106 and Ground Water 106, respectively. The majority of both allocations are used to pay salaries of staff in various OWQ programs while the remaining funds pay for travel, equipment and supplies related primarily to OWQ's monitoring activities.

10.3.2 CWA SECTION 319 GRANT FUNDS

Federal CWA Section 319 funds are granted to IDEM by U.S. EPA for the purposes of addressing Indiana's nonpoint source pollution issues. This funding source has remained relatively stable over the past few years, with approximately \$2.9 million available each year after the administrative costs and salaries of staff that administer the Nonpoint source grant programs are deducted. Indiana provides a 40 percent match for these funds. The majority of the remaining funds have been passed through as state grants to external organizations for watershed management planning and restoration activities. However, OWQ plans to allocate a larger share of available funds to support OWQ's monitoring activities described in this *Strategy*

to measure the success of its programs and to support watershed planning efforts and to measure the success of the Nonpoint Source Program in restoring water quality.

10.3.3 LABORATORY SERVICES CONTRACT FUND

OWQ's Laboratory Services Contract Fund comes from funds dedicated by the Indiana State Legislature to support environmental monitoring activities. This funding continues to provide critical support for OWQ's surface and ground water monitoring activities. However, in recent years, the total amount dedicated has been reduced by about \$200,000 each year. The state takes a portion of the total allocation for Legislative Reserve, which cushions the state against shortfalls in projected revenues. The amount withdrawn as Legislative Reserves for the federal fiscal year 2011 was seven percent. Given the current economic climate, it may be reasonable to expect this percentage to increase, which will further reduce the funding available to OWQ.

The Laboratory Services Contract Fund is used primarily to pay for analytical work done by contract laboratories and is shared among all IDEM offices that use contract laboratories for analytical services. The funds allocated to OWQ are shared between the WAPB and the Drinking Water Branch (DWB). The WAPB finances contract lab services with this fund, such as:

- Probabilistic monitoring chemistry analysis
- Targeted monitoring chemistry analysis
- Fish tissue and sediment contaminants analysis
- Algal (chlorophyll a) analysis

The DWB uses its share of these funds to cover the analytical cost of samples collected through its Ground Water Monitoring Network and its Citizen Complaint Monitoring Program.

10.3.4 CWA SUPPLEMENTAL 106 GRANT FUNDS

Each budget cycle, U.S. EPA sets aside a portion of the total CWA 106 Funds awarded by Congress. This appropriation is passed through to states as CWA Supplemental 106 Grant Funds, which are typically awarded as one- to two-year grants to support state monitoring activities.

The WAPB and DWB coordinate to develop proposals for these funds which commonly include different projects to enhance their respective monitoring programs. Currently, OWQ uses Supplemental 106 funds to support the following monitoring activities described in this *Strategy*:

- Toxic algae monitoring in lakes
- Probabilistic algal community monitoring in streams
- Ambient ground water monitoring

10.3.5 CWA SECTION 205(J) GRANT FUNDS

CWA Section 205(j) allows states to reserve up to one percent of their annual Title II Clean Water Construction Grant allocation for water quality management planning activities. These funds are awarded to OWQ as a grant, of which 40 percent must be passed through as state grants specifically to regional planning organizations. The remaining 60 percent of these funds may be either passed through as grants to external organizations or used internally by OWQ for projects that support water quality assessment and planning projects.

CWA 205(j) allocations vary from year to year. Since 2005, the maximum potential allocation available for grants to external organizations and internal projects (60 percent of the total allocation) has ranged from \$98,000 - \$158,000 since 2005. It is anticipated that in future funding cycles, a larger share of available funds directed to support OWQ's monitoring activities described in this *Strategy* may be needed to support nutrient criteria development and watershed planning efforts.

10.3.6 SERVICES PROVIDED BY PARTNERING AGENCIES

Although this category is not in principle a funding source, it is important to recognize the value of sample analysis done by the ISDH for the fixed station monitoring completed by the WAPB. This is comparable to other funding sources in its capacity to provide the WAPB with the ability to complete year-round monitoring at fixed stations to develop State water quality trends and watershed baselines. IDNR also provides valuable QA/QC support to OWQ in the form by allowing one of its aquatic biologists to perform voucher checks for 10% of the fish community samples collected by the WAPB.

10.4 FUTURE NEEDS

At the submission of the 2006 *Strategy*, the Assessment Branch (now the WAPB) was comprised of 37 fulltime monitoring staff. Although with OWQ's recent reorganization it may appear that

there has been an increase of staff, many of these staff members have responsibilities other than monitoring, such as total maximum daily load development, , facilitating watershed planning at the local level, and nonpoint source grant administration. This *Strategy* has attempted to deal with staff and budget reductions by creating efficiencies in spite of the circumstances. These include:

- Revising the current probabilistic monitoring approach
- Revising the current fixed station monitoring approach
- Cross-training staff to work in other areas
- Organizing monitoring logistics for maximum effort

10.4.1 CURRENT AND FUTURE STAFFING NEEDS

Although the WAPB's monitoring efforts have been organized to more efficiently meet this *Strategy's* objectives, staff and financial resources are currently spread very thin covering these needs where possible, at a bare minimum. Support is needed in specific areas, especially in those positions of coordination. Future staffing needs consist of these personnel:

Water Monitoring Coordinator (Environmental Manager 2): This *Strategy* as a whole represents a significant departure from previous monitoring approaches and introduces a significant level of complexity into day-to-day monitoring activities. Successful implementation of this *Strategy* will require highly organized, active coordination of monitoring activities and laboratory resources, both at the beginning of the sampling season during the planning stages and throughout its implementation. The Water Monitoring coordinator will have an understanding of the monitoring requirements and constraints associated with each type of monitoring the WAPB conducts and will coordinate across WAPB Sections to help ensure the timely completion of all monitoring activities.

Lakes Monitoring Coordinator – This person will fill an eliminated position that coordinates monitoring efforts with IU/SPEA lakes monitoring program and volunteers. Not only will this person facilitate lakes monitoring objectives, but he/she will be instrumental in implementing future changes in the lakes monitoring program

Environmental/Biological Statistician (Senior Environmental Manager 1) – This person will work with monitoring staff to analyze existing and new data to meet multiple water quality management needs including development of nutrient criteria and new biological indices and to explore and implement new methods for trend analyses.

Logistical Administrator – This person will work within the WAPB, across sections, to organize equipment and supply logistics, and provide administrative and financial support for all staff. This position will take on a workload currently carried by multiple individual monitoring staff persons, allowing for better use of their technical skills.

10.4.2 TRAINING NEEDS

Another important way to build on the efficiencies achieved by this *Strategy* is enhance the training currently available to WAPB staff. OWQ's reorganization, which combines both monitoring staff and staff responsible for administering the programs that rely on the water quality data they collect, has created unprecedented opportunities for synchronization between programs, which will be further enhanced to the extent that staff understand the functions of different programs, identify areas in which they may use skills that are currently underutilized, and can gain additional skills that will allow them to more effectively contribute to other programs areas when needed. All of these benefits will require cross-training to achieve. Examples of the types of cross-training that would allow the WAPB to more effectively leverage its existing staff resources include:

- TMDL development
- Water quality assessments
- Statistical data analysis and water quality modeling
- Watershed planning and management
- Nonpoint source 319 grant administration
- Biological monitoring
- Water chemistry monitoring
- Data quality review processes

10.4.3 LABORATORY RESOURCES NEEDED

With the recent addition of diatom analyses and microcystin work, the biological laboratory has become overcrowded. To remedy this situation, the WAPB is exploring the possibility of relocating the algal monitoring laboratory to the building that houses the WAPB's bacteriology laboratory. While there is sufficient space in this building to accommodate the WAPB's algal laboratory work, this move would require additional equipment, including:

- The installation of a fume hood with a centrifuge
- New glassware
- A chemical cabinet
- A computer and monitor
- A microscope equipped with a camera

The cost of the microscope is known and has been worked into the budget in Appendix 1 while the other costs associated with this move are still being determined.

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APPENDIX 1: BUDGET FOR SURFACE WATER AND GROUND WATER MONITORING PROGRAMS

APPENDIX 3: TECHNICAL DATA SHEETS

Placeholder: These documents are currently being revised to incorporate the changes made to this *Strategy*.

APPENDIX 4: SURVEY REQUEST FORM

Placeholder: This form is currently being modified.